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(54) **METHOD FOR FABRICATING ABSORBENT ARTICLES**

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See application file for complete search history.

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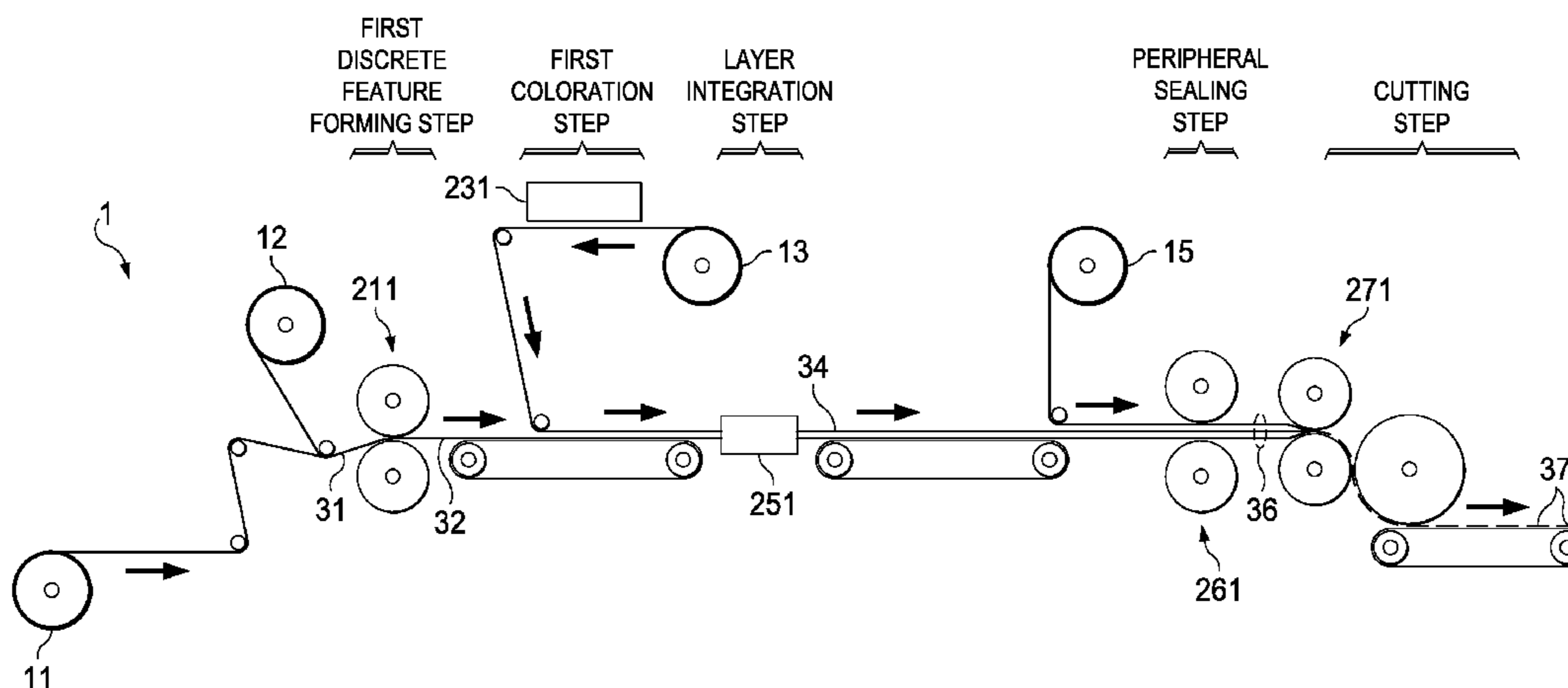
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(57) **ABSTRACT**

The present invention relates to a method for fabricating absorbent article having multiple layers, and deformed zones of targeted performance, and colored regions, the method comprising the steps of forming discrete features on at least one layer, printing colored regions on at least one layer, integrating multiple layers to form an absorbent assembly, and cutting the absorbent assembly into individual absorbent articles, wherein the steps are carried out continuously.

27 Claims, 9 Drawing Sheets



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| <i>A61F 13/512</i> | (2006.01) | <i>2013/15991</i> (2013.01); <i>A61F 2013/51165</i> |
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| <i>B32B 7/04</i> | (2006.01) | <i>B32B 38/04</i> (2013.01); <i>B32B 38/06</i> (2013.01); |
| <i>B32B 7/08</i> | (2006.01) | <i>B32B 38/145</i> (2013.01); <i>B32B 38/1833</i> |
| <i>B32B 38/04</i> | (2006.01) | (2013.01); <i>B32B 38/1875</i> (2013.01); <i>B32B</i> |
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| <i>B32B 38/00</i> | (2006.01) | (2013.01); <i>B32B 2305/20</i> (2013.01); <i>B32B</i> |
| <i>B32B 3/30</i> | (2006.01) | <i>2307/724</i> (2013.01); <i>B32B 2310/028</i> |
| <i>B32B 37/00</i> | (2006.01) | (2013.01); <i>B32B 2555/00</i> (2013.01); <i>B32B</i> |
| <i>B32B 37/02</i> | (2006.01) | <i>2555/02</i> (2013.01); <i>Y10T 156/1044</i> (2015.01) |
| <i>B32B 37/20</i> | (2006.01) | |
| <i>B32B 37/22</i> | (2006.01) | |
| <i>B32B 38/18</i> | (2006.01) | |
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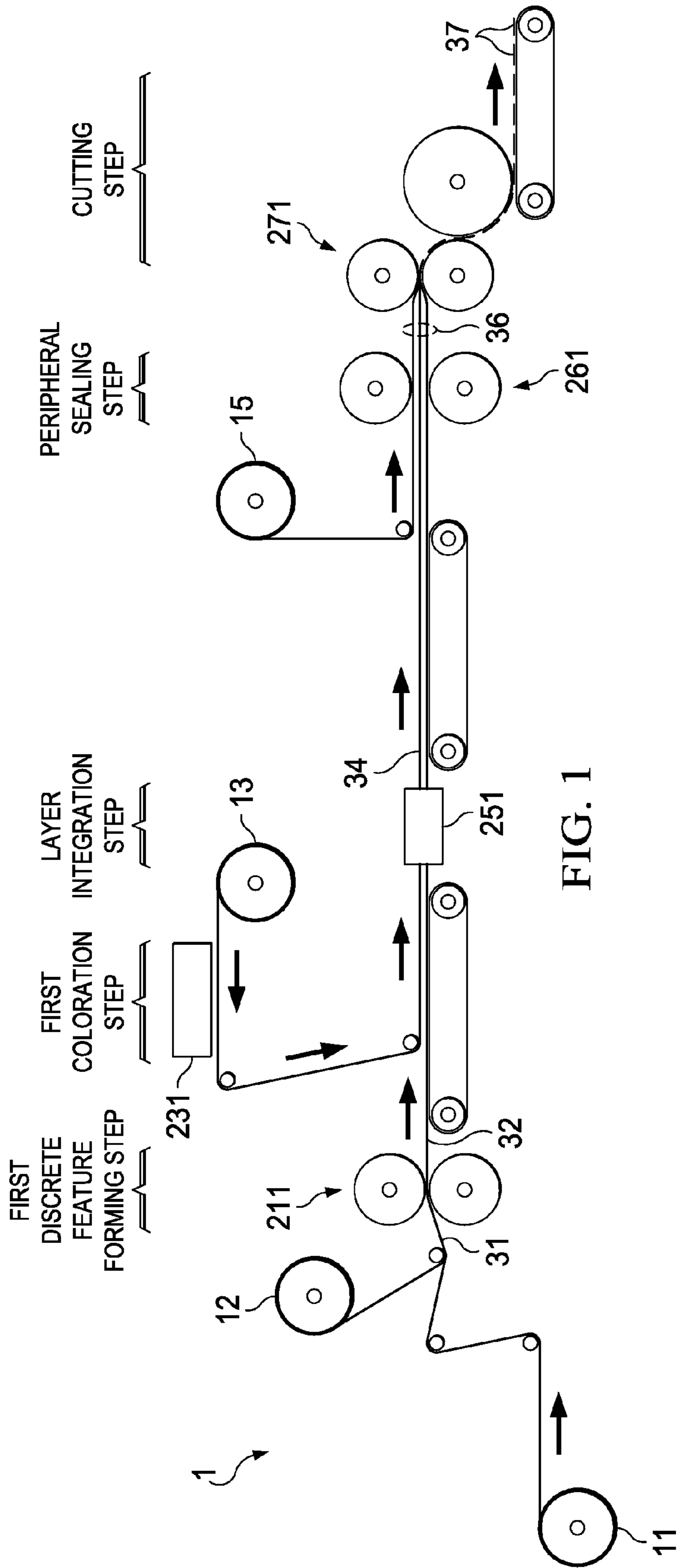


FIG. 1

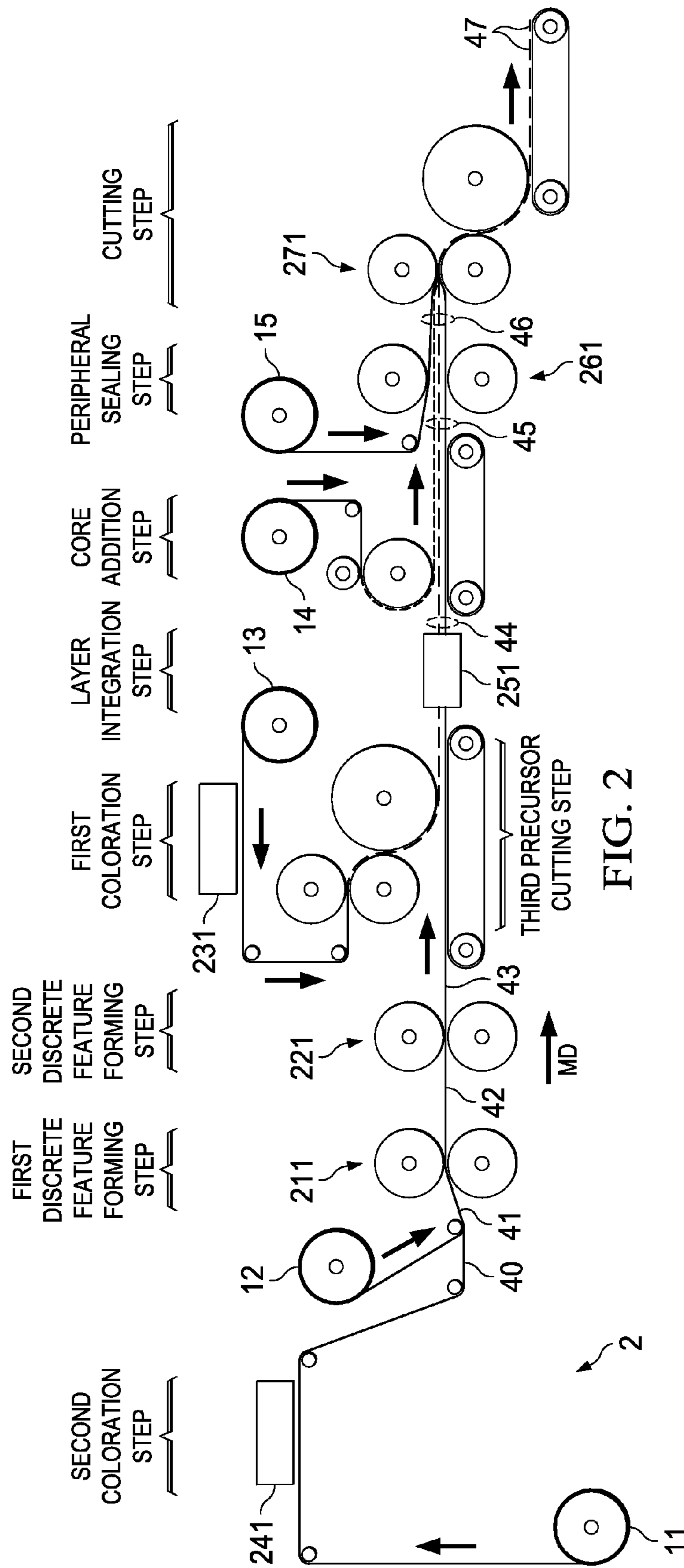
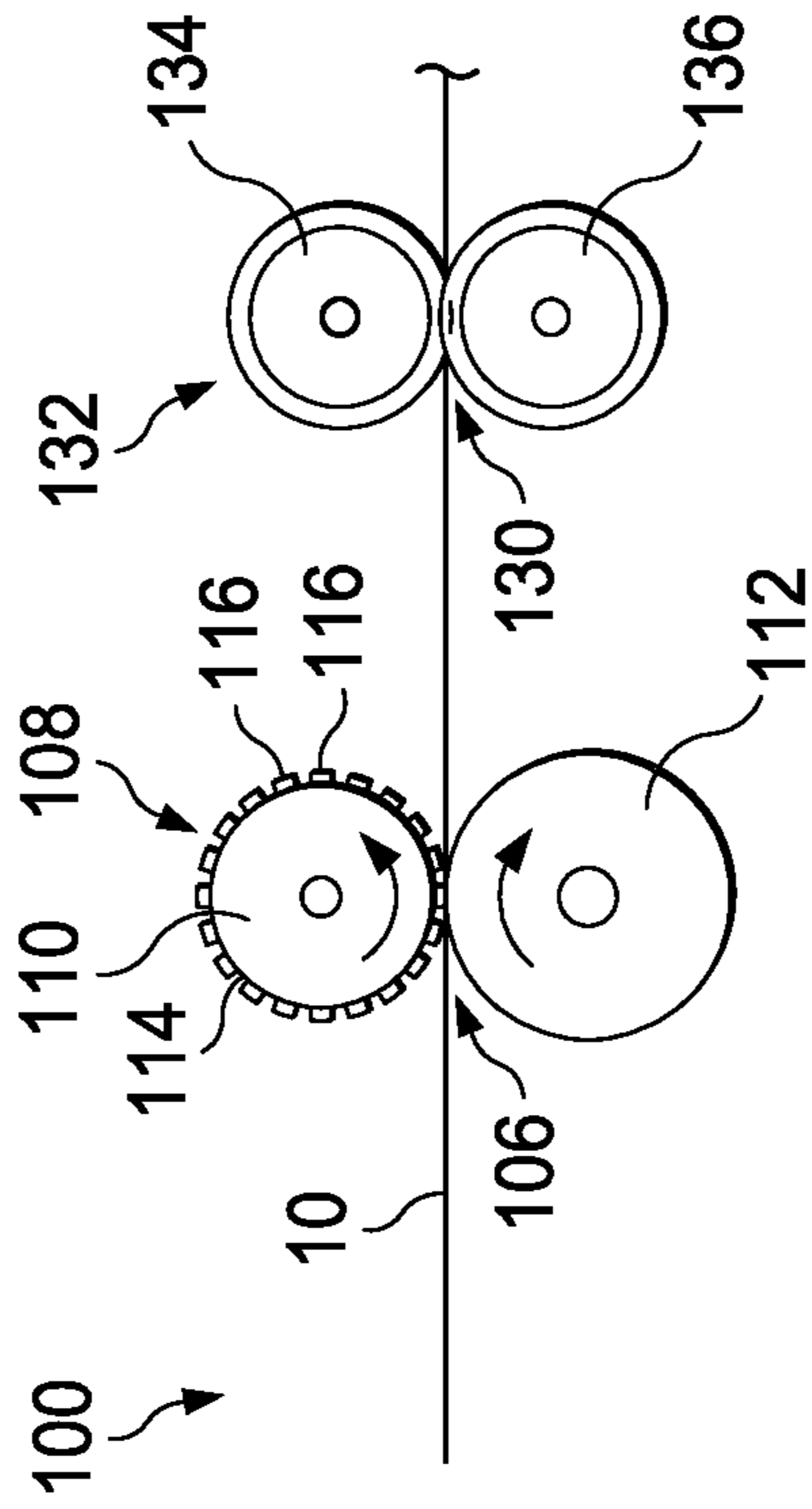
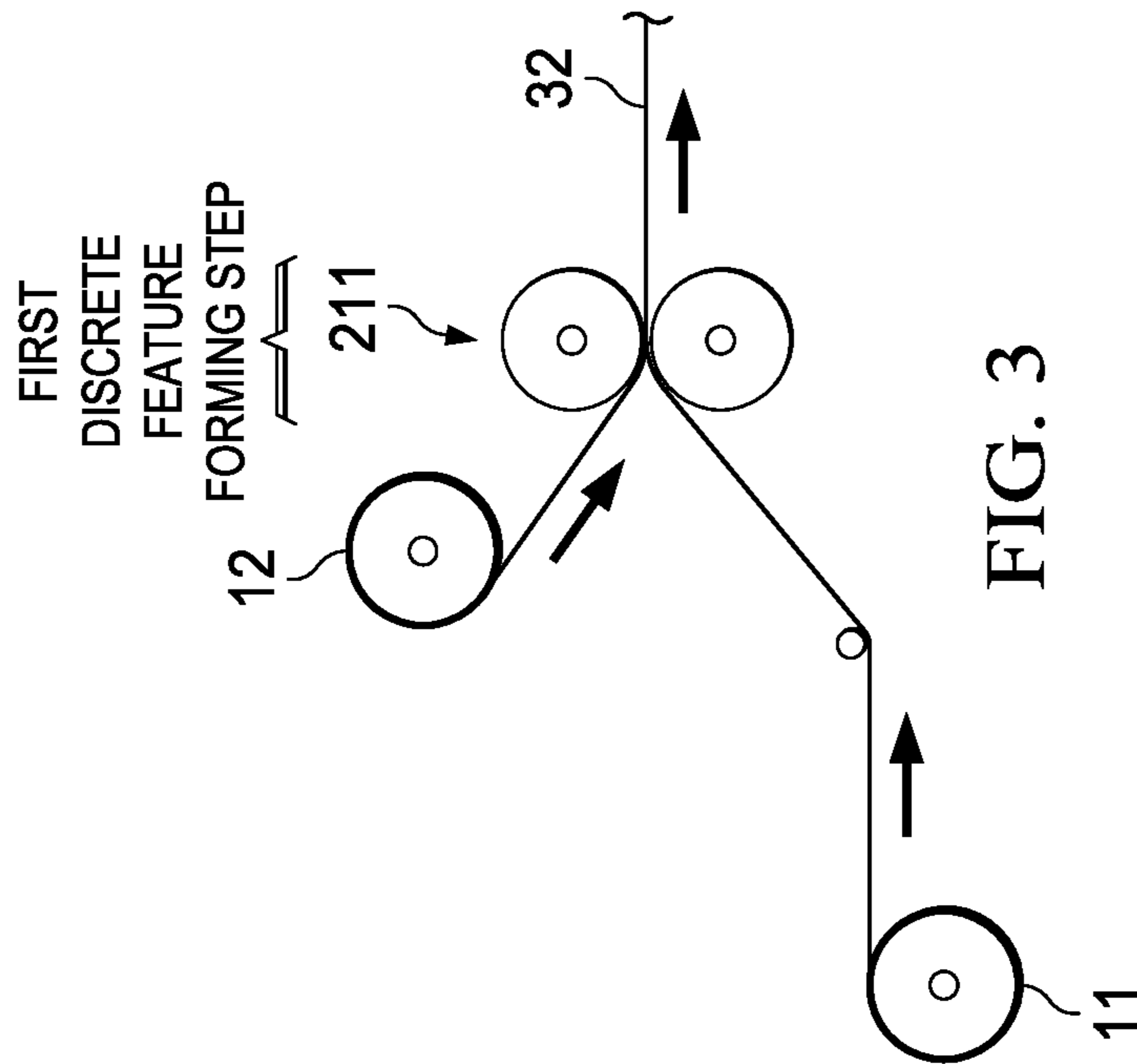
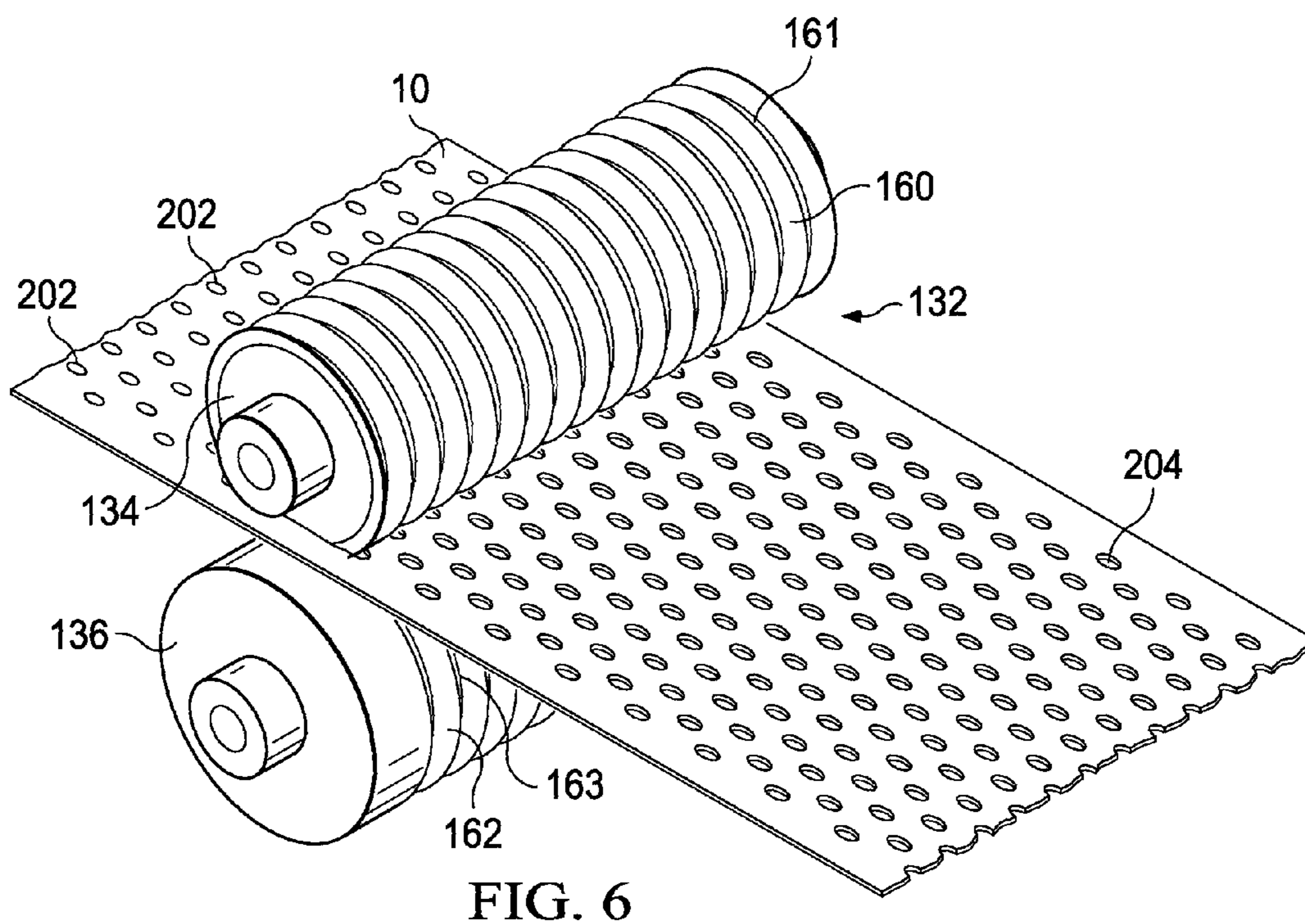
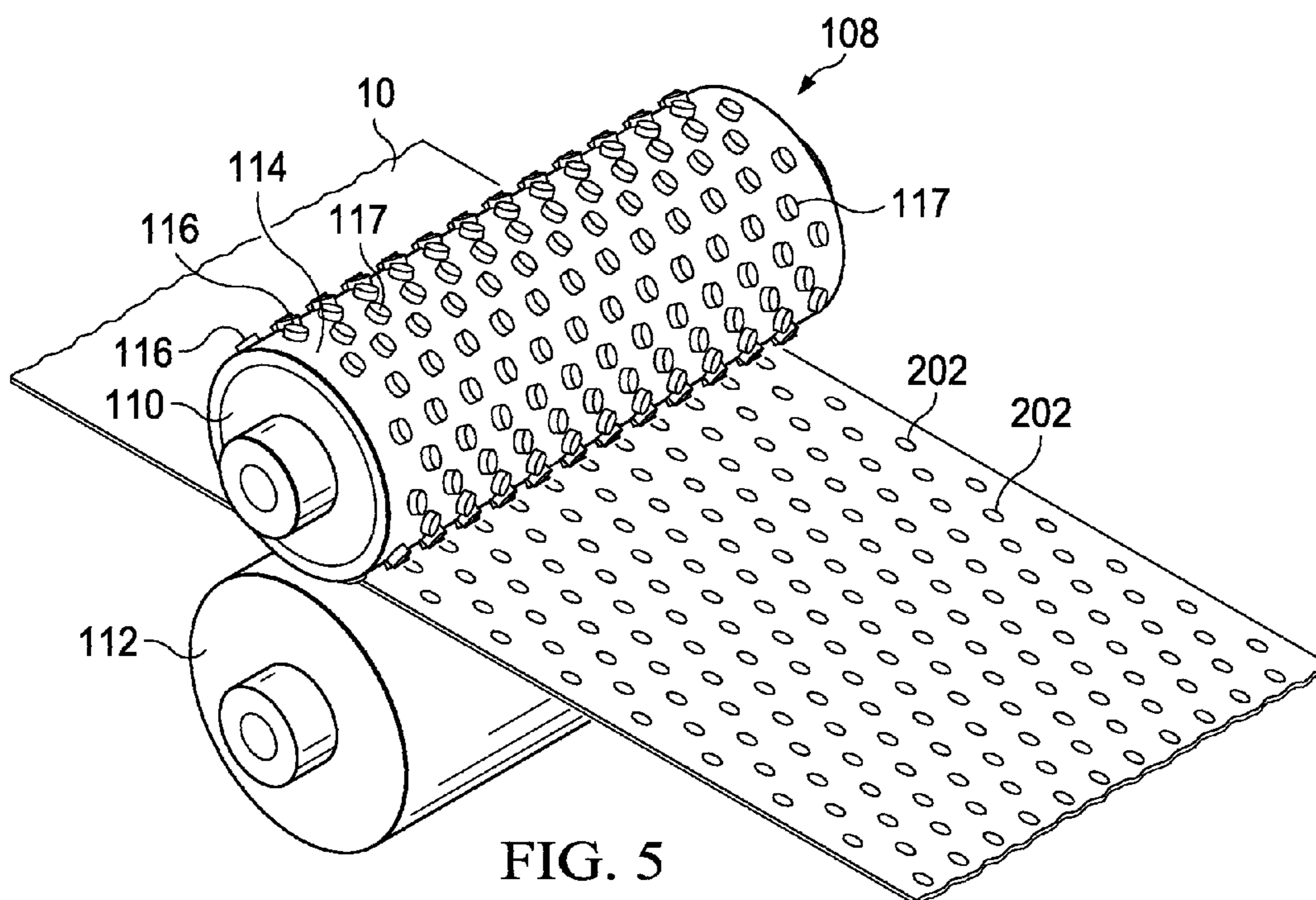


FIG. 2





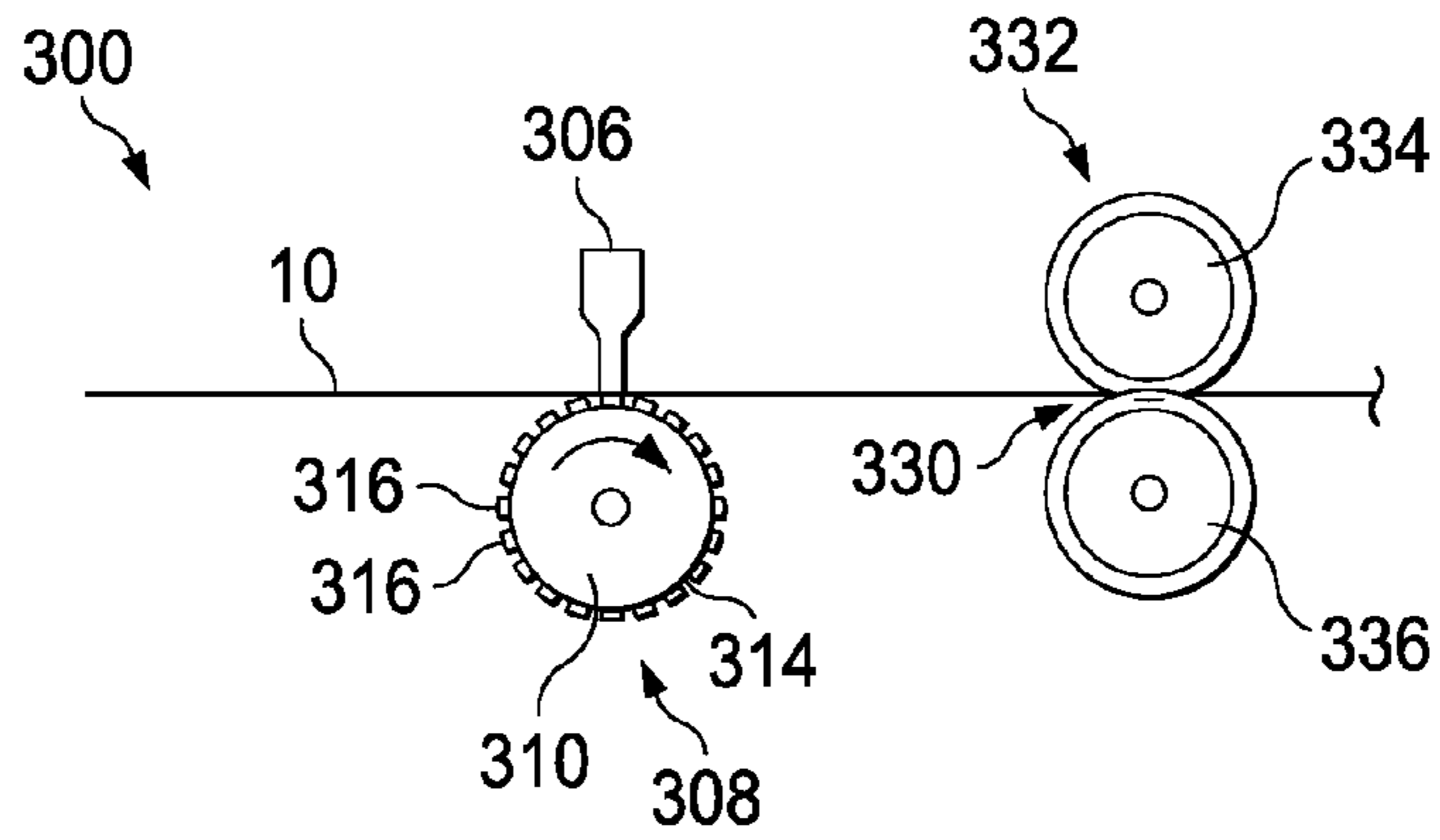


FIG. 7

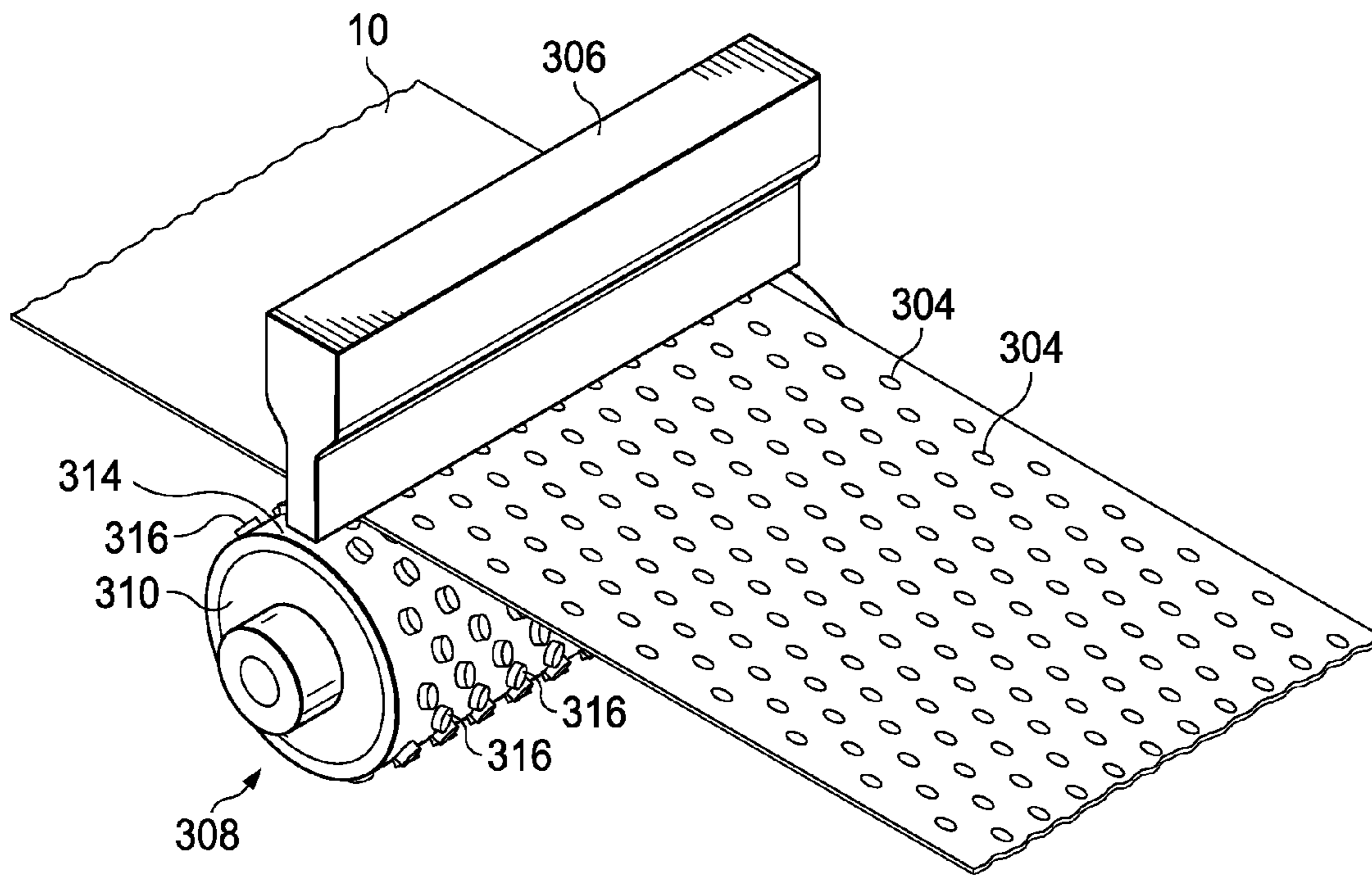


FIG. 8

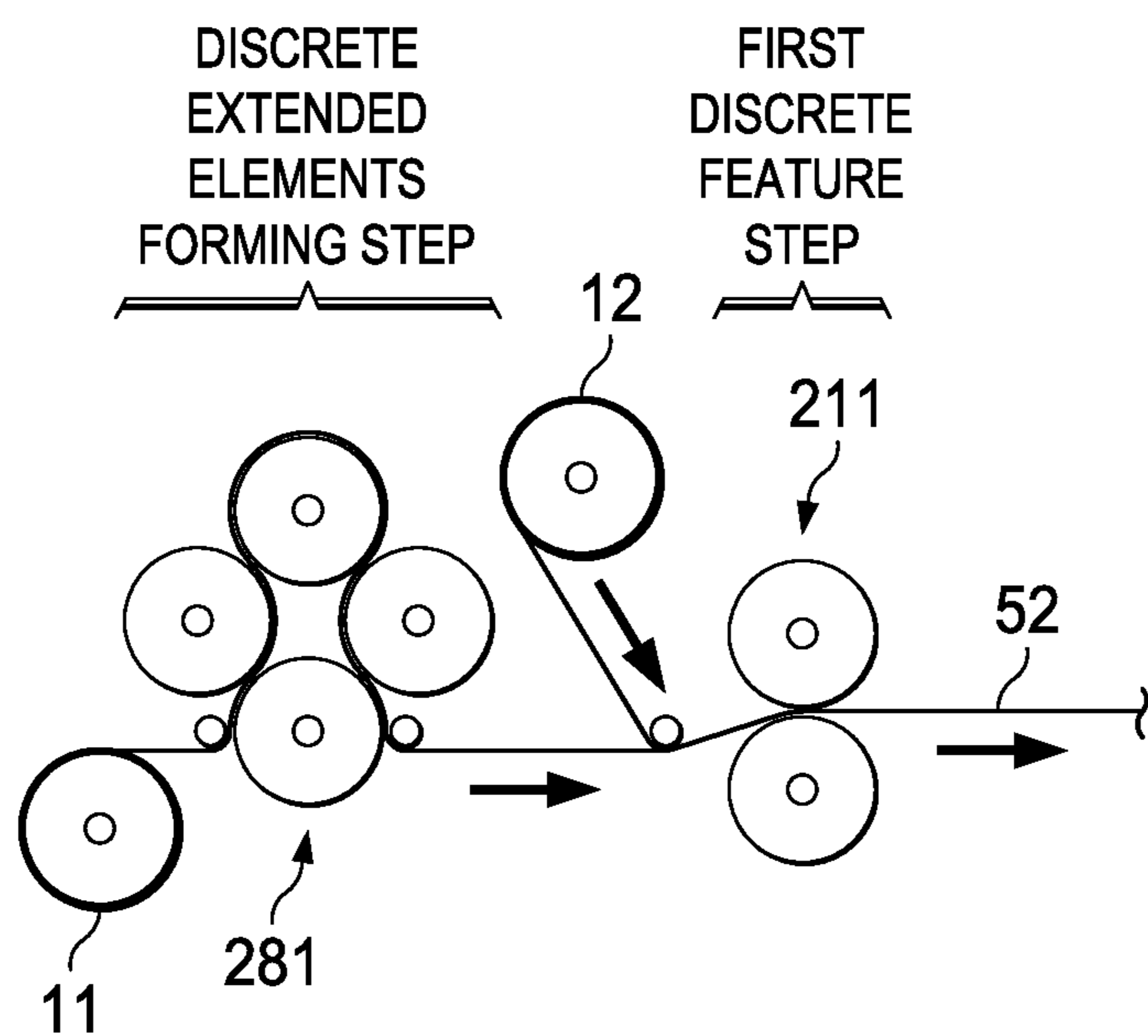


FIG. 9

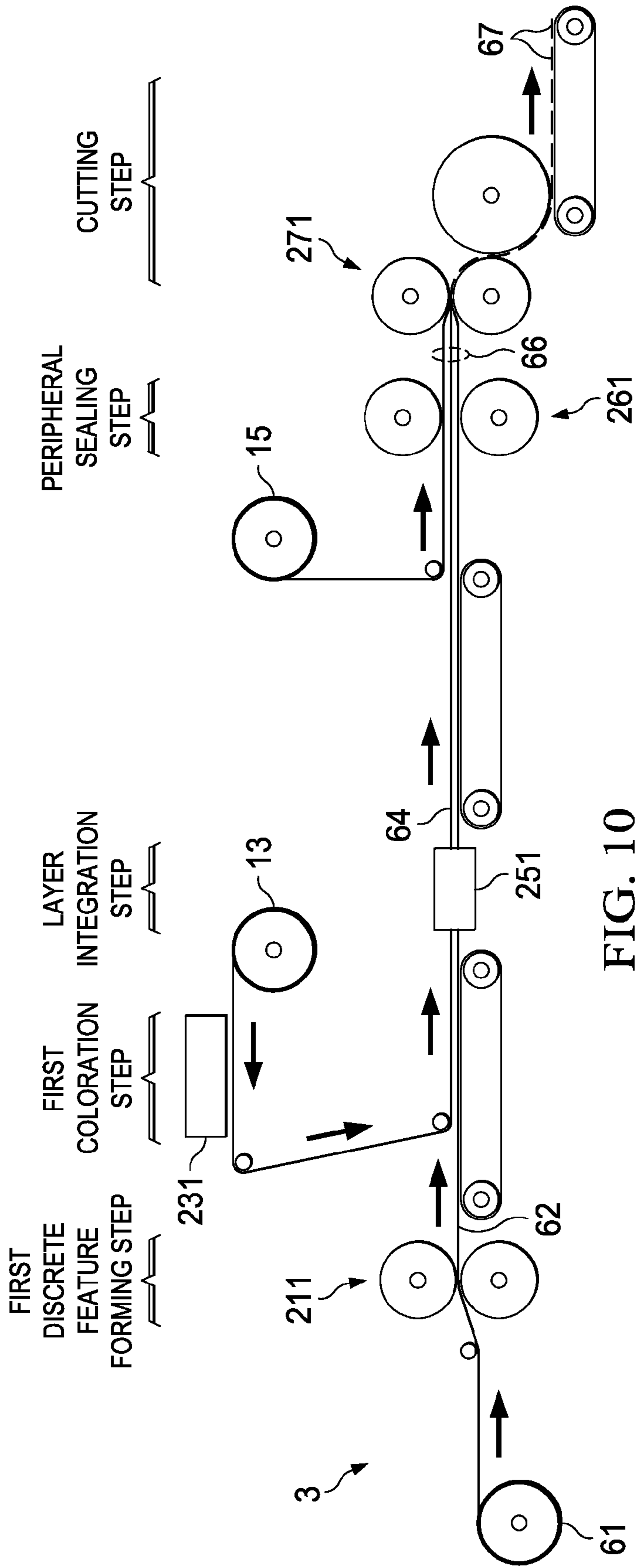


FIG. 10

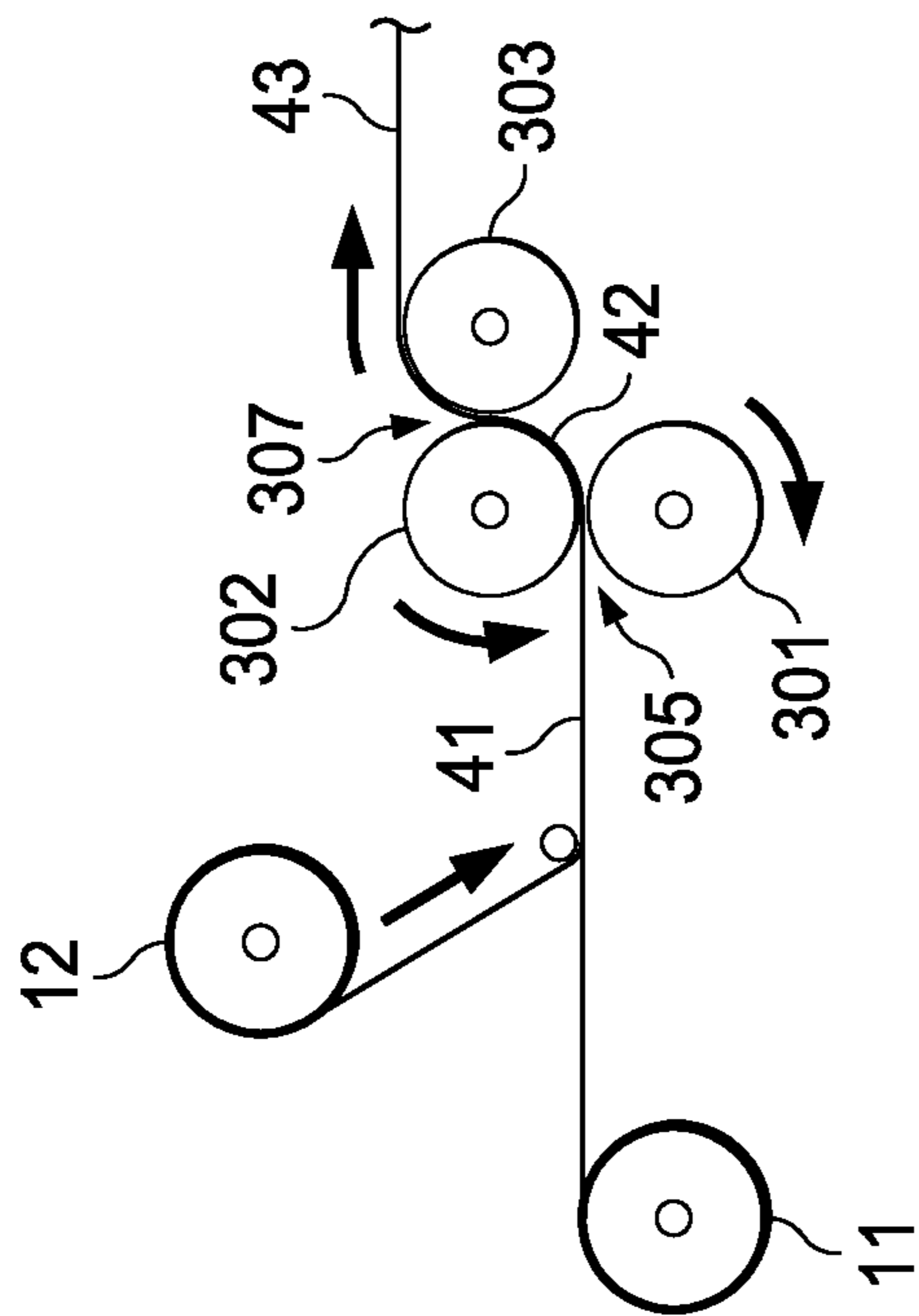


FIG. 11A

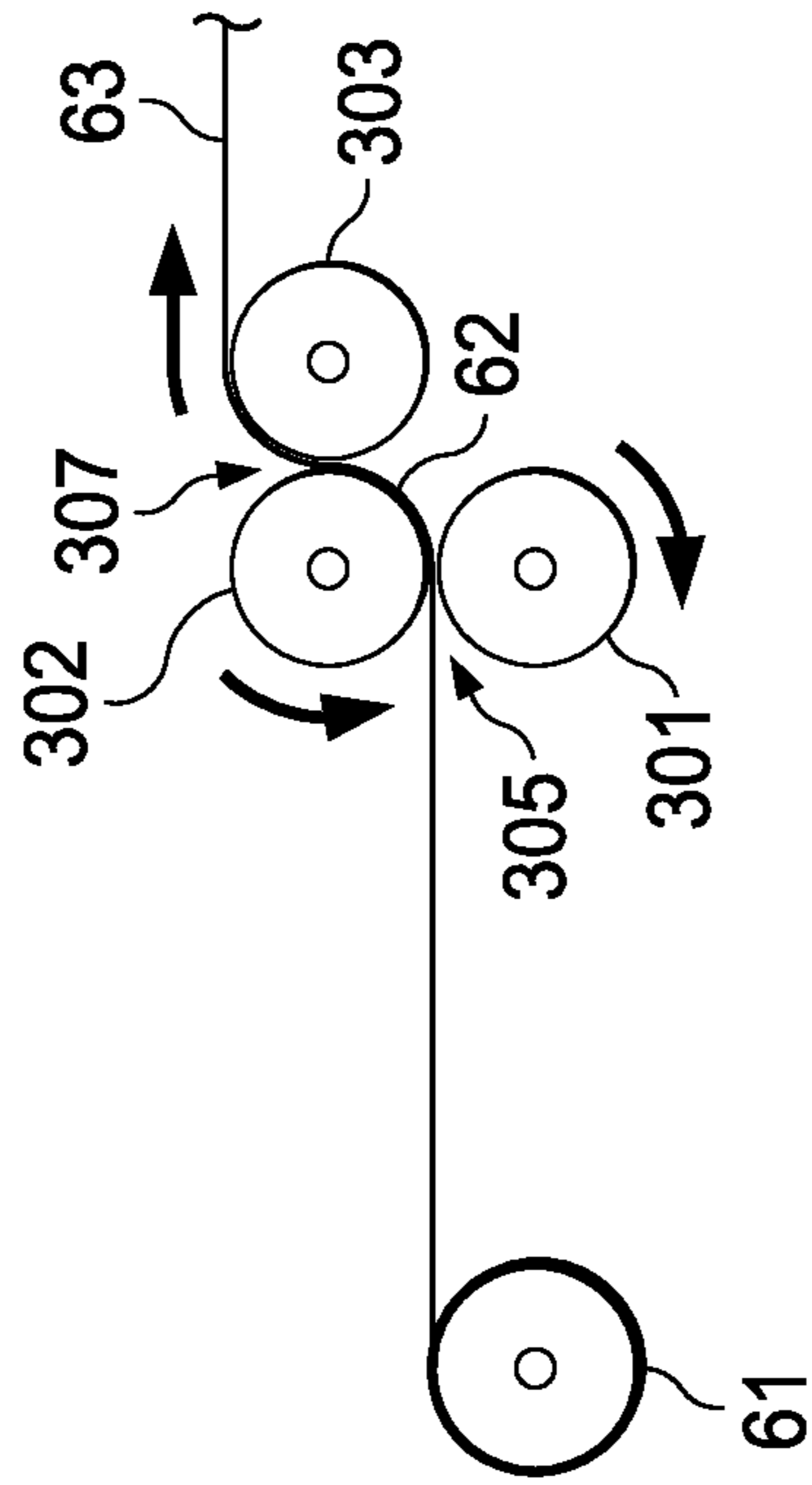


FIG. 11B

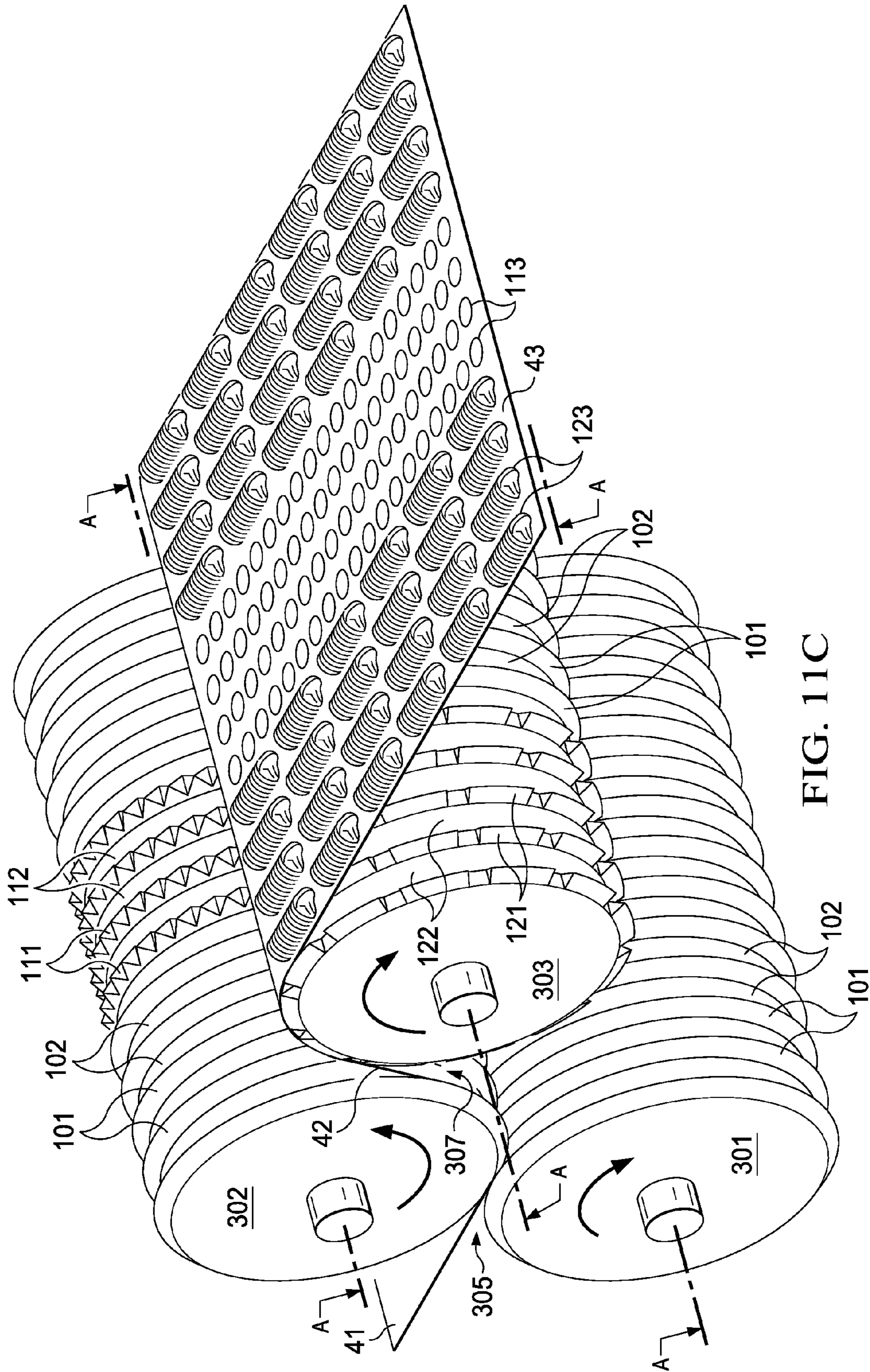


FIG. 11C

1

METHOD FOR FABRICATING ABSORBENT ARTICLES

FIELD OF THE INVENTION

The present invention relates to methods for fabricating absorbent articles. Specifically, the method can be used to fabricate absorbent articles having a colored region and a deformed topsheet in a continuous process.

BACKGROUND OF THE INVENTION

Absorbent articles such as sanitary napkins and female adult incontinence articles that function to collect fluid discharged from a woman's vagina or urethra often include a deformed surface region and a colored region in the absorbent article.

A colored region on or below a top surface of an absorbent article that is visible through a topsheet can provide functional and perceptual advantages. The colored region can overcome a problem of unsightly staining during, for example, a woman's menstrual period. The colored region on a layer below the topsheet, which can be viewed through the topsheet, can also provide for a perception of depth and greater fluid storage capacity within the absorbent article. In addition, by including a colored region in the central portion of the absorbent article, manufacturers of absorbent articles may effectively teach consumers that the central portion of the absorbent article is where the fluid collected should reside.

Meanwhile, various fluid handling demands on different portions of an absorbent article, different physical interactions between portions of an absorbent article and portions of a wearer's body, and different moisture and chemical environments of different portions of a wearer's crotch region create unique needs for different regions of the topsheet. Some absorbent articles designed to have a topsheet with deformed regions that are arranged to provide fluid handling benefits where needed and/or skin comfort benefits where needed are, for example, disclosed in WO 10/17360; WO 10/17362; and WO 10/17351.

Provision of a colored region and/or deformed regions on a web has been carried out separately from an absorbent article fabrication.

In many cases to provide best functionality of absorbent articles, it is best to provide each step of the manufacturing process next to each other and in the right sequence so that one does not have issues with performance of the absorbent articles that could occur if made separately. For instance, formation of features in a topsheet far apart or in a different sequence may cause weakening of the topsheet structure, thereby causing tearing in use or during the manufacturing process. Further, separation of unit steps of feature formations may increase the possibility that some or many features closely co-located in a topsheet formed in different unit steps overlap which leads to increased aperture size which would cause rewet problems.

Accordingly, there is a need for a process which can provide zones of targeted performance, and colored regions in a high-speed continuous operation.

SUMMARY OF THE INVENTION

The present invention is directed to a method for fabricating absorbent article having multiple layers, deformed zones of targeted performance, and colored regions, the method comprising the steps of forming discrete features on

2

a topsheet, printing a colored region on at least one layer, integrating multiple layers to form an absorbent assembly, and cutting the absorbent assembly into individual absorbent articles, wherein the steps are carried out continuously.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic representation of a process of the present invention.

FIG. 2 is a schematic representation of another embodiment of a process of the present invention.

FIG. 3 is a schematic representation of another means of forming first discrete features in a process of the present invention.

FIG. 4 is a schematic representation of an exemplary process for selectively aperturing a web in the process of the present invention;

FIG. 5 is an enlarged perspective illustration of a web weakening arrangement of the process of FIG. 4.

FIG. 6 is an enlarged perspective illustration of an incremental stretching system in the process of FIG. 4.

FIG. 7 is a schematic representation of another process for selectively aperturing a web in the process of the present invention;

FIG. 8 is an enlarged perspective illustration of another web weakening arrangement of the process of FIG. 7.

FIG. 9 is a schematic representation of optional discrete extended elements forming step of a process of the present invention.

FIG. 10 is a schematic representation of another embodiment of a process of the present invention.

FIG. 11A is a schematic representation of another means of forming first and second discrete features in a process of the present invention.

FIG. 11B is a schematic representation of another means of forming first and second discrete features in a process of the present invention.

FIG. 11C is perspective representation of an apparatus and a method shown in FIG. 11A for forming first and second discrete features in a process of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

The term "absorbent article", as used herein, includes disposable articles such as sanitary napkins, panty liners, diapers, adult incontinence articles, and the like. Such absorbent articles are intended for the absorption of body liquids, such as menses or blood, vaginal discharges, urine, and feces. Various absorbent articles described above will typically comprise a liquid permeable topsheet, a liquid impermeable backsheet joined to the topsheet, and an absorbent core between the topsheet and backsheet.

The term "aperture", as used herein, refers to a hole. The apertures can either be punched cleanly through the web so that the material surrounding the aperture lies in the same plane as the web prior to the formation of the aperture, or holes formed in which at least some of the material surrounding the opening is pushed out of the plane of the web. In the latter case, the apertures may resemble a protrusion or depression with an aperture therein.

The term 'color' as referred to herein includes any color, i.e., white, black, red, blue, violet, orange, yellow, green, and indigo as well as different shades thereof or mixtures thereof.

The term “component” of an absorbent article, as used herein, refers to an individual constituent of an absorbent article such as a topsheet, acquisition layer, liquid handling layer, absorbent core or layers of absorbent cores, back-sheets, and barriers such as barrier layers and barrier cuffs, and functional or aesthetic design elements such as colored regions, channels, and features formed on a topsheet.

The term “comprising”, as used herein and in the claims, is inclusive or open-ended and does not exclude additional unrecited elements, compositional components, or method steps.

The term “discrete”, as used herein, means distinct or unconnected. When the term “discrete” is used relative to forming elements on a forming member, it is meant that the distal (or radially outwardmost) ends of the forming elements are distinct or unconnected in all directions, including in the machine and cross-machine directions (even though bases of the forming elements may be formed into the same surface of a roller, for example).

The term “forming elements”, as used herein, refers to any elements on the surface of a forming member such as a roller that are capable of deforming a web. The term “forming elements” includes both continuous or non-discrete forming elements such as the ridges and grooves on ring rolls, and discrete forming elements.

The term “joined”, as used herein, refers to the condition where a first component is affixed, or connected, to a second component either directly; or indirectly, where the first component is affixed, or connected, to an intermediate component which in turn is affixed, or connected, to the second component. The joined condition between the first component and the second component is intended to remain for the life of the absorbent article.

The term “machine direction” or “MD”, as used herein, refers to the path that material, such as a web, follows through a manufacturing process, while the term “cross machine direction” or “CD” is the direction substantially perpendicular to the MD and in the plane generally defined by the web. Directions within 45 degrees of the cross direction are considered to be cross directional.

The term “nonwoven”, as used herein, refers to a material having a structure of individual fibers or threads which are interlaid, but not in a repeating pattern as in a woven or knitted fabric, which do not typically have randomly oriented fibers. Nonwoven has been formed from many processes, such as, for example, meltblowing processes, spunbonding processes, hydroentangling, and bonded carded web processes, including carded thermal bonding. The constituent fibers of a nonwoven can be polymer fibers, and can be monocomponent, bicomponent, and/or biconstituent, and a mixture of different fiber types.

The term “odor control composition”, as used herein, refers to such compositions usually contain, sometimes along with conventional perfume ingredients, ingredients which are able to chemically react with the malodorous molecules released from the body fluids (such as ammonia) thus neutralizing the source of the malodor, and/or ingredients which are able to interact with nose receptors so that their perception of the malodorous molecules is reduced.

The term “phase”, as used herein, refers to the positional relationship between two or more parts of a machine that performs repetitive motion. For example, phase may refer to the relative position of a punch that stamps apertures into a component used in the manufacturing process. When utilized as verbs, the terms “phasing,” “phased,” “phase,” and the like refer to the act of changing the phase of a device from one phase to another. For example, the act of phasing

a roller may refer to advancing or retarding the rotation of the roller about its primary axis.

The term “polymer” generally includes, but is not limited to, homopolymers, copolymers, such as for example, block, graft, random and alternating copolymers, terpolymers, etc., and blends and modifications thereof. In addition, unless otherwise specifically limited, the term “polymer” includes all possible geometric configurations of the material. The configurations include, but are not limited to, isotactic, atactic, syndiotactic, and random symmetries.

The term “tuft”, as used herein, refers to a particular type of protrusion. Tufts may have a tunnel-like configuration, and in some cases may be open at one or both of their ends.

The term “upper”, as used herein, refers to absorbent members, such as layers, that are nearer to the wearer of the absorbent article during use, i.e. towards the topsheet of an absorbent article; conversely, the term “lower” refers to absorbent members that are further away from the wearer of the absorbent article towards the backsheet.

The term “web”, as used herein, refers to any suitable deformable material, such as a woven, nonwoven, film, combination, or laminate of any of the foregoing materials. Absorbent Article

Absorbent articles manufactured by a method according to the present invention comprise a liquid permeable deformed topsheet; a liquid permeable colored sheet, and a liquid impermeable backsheet joined to the topsheet, wherein the topsheet comprises a first layer and a second layer, and have a plurality of first discrete features; wherein the colored sheet has a first colored region and comprises a colored sheet web; and wherein the backsheet comprises a backsheet web. In one embodiment, the topsheet further comprises a plurality of second discrete discrete features.

Each of the first layer and the second layer can be a polymer film, a nonwoven, a composite comprising a polymer film or a nonwoven, or laminate comprising a polymer film or a nonwoven. In one embodiment, the first layer is a first polymer film and the second layer is selected from a nonwoven and a second polymer film. In the embodiment the first polymer and second polymer films may be the same or different polymer films. In another embodiment, the first layer is a first nonwoven and the second layer is selected from a polymer film and a second nonwoven. In this embodiment, the first and the second nonwovens may be the same or different materials.

In one embodiment, when at least one of the first and second layers is a polymer film, the the polymer film is a polymer film including materials normally extruded or cast as films such as polyolefins, nylons, polyesters, and the like. Such films can be thermoplastic materials such as low density polyethylene, medium density polyethylene, high density polyethylene, linear low density polyethylene, polypropylenes and copolymers and blends containing substantial fractions of these materials.

The polymer film can have a plurality of discrete extended elements. Patent publications disclosing such a plurality of discrete extended elements include WO 01/76842; WO 10/104996; WO 10/105122; WO 10/105124 and US2012027701A1. In one embodiment, the polymer film can have a plurality of discrete extended elements comprising open proximal ends, open or closed distal ends, and sidewalls, wherein the discrete extended elements comprise thinned portions at the distal ends of the discrete extended elements and/or along the sidewalls of the discrete extended elements, and wherein the discrete extended elements have a diameter of less than about 500 microns; the discrete extended elements have an aspect ratio of at least about 0.2;

and/or the polymer film comprises at least about 95 discrete extended elements per square centimeter.

In another embodiment, when at least one of the first and second layers is a nonwoven, the nonwoven constituting the topsheet is a colored nonwoven.

In the present invention, the colored sheet comprising a colored sheet web may function as a secondary topsheet in an absorbent article. The colored sheet web can be any sheet material that allows a colored region to be readily seen from a body-facing surface of an absorbent article, and can be manufactured from a wide range of materials such as woven, nonwoven materials, latex or thermally bonded airlaid materials, polymeric materials such as apertured formed thermoplastic films, apertured plastic film, hydro formed thermoplastic films, porous foams, reticulated foams, reticulated thermoplastic films and thermoplastic scrims.

In the present invention, a backsheet web can be any backsheet material commonly used for absorbent articles such as polyolefinic films like polyethylene, polypropylene and a combination thereof. In some embodiments, the backsheet may be impervious to malodorous gases generated by absorbed bodily discharges, so that the malodors do not escape. The backsheet may or may not be breathable.

An absorbent article manufactured by the method according to the present invention has a background region and a first colored region, and optionally a second colored region being viewable from the body-facing surface of the absorbent article. The background region is visually distinguishable from the first colored region and the optional second colored region. The background region can be white or any other color visually distinguishable from the first colored region and second colored region. The first colored region and the optional second colored region can be visually distinguishable in terms of color and/or shade of a color. Colors are believed to be visually distinguishable if there is a ΔE calculated according to the equation below between the two colors of at least about 1. The first colored region and the second colored region, respectively, can have multiple colored regions. The multiple colored regions can be visually distinguishable in terms of color and/or shade of a color.

The color of the first colored region, the second colored region and background region are measured by the reflectance spectrophotometer according to the method disclosed in WO 11/25486. The difference in color is calculated using the L^* , a^* , and b^* values by the formula $\Delta E = [(L^*_X - L^*_Y)^2 + (a^*_X - a^*_Y)^2 + (b^*_X - b^*_Y)^2]^{1/2}$. Herein, the 'X' in the equation may represent the first colored region, the second colored region or the background region, and 'Y' may represent the color of another region against which the color of such region is compared. X and Y should not be the same two points of measurement at the same time.

The absorbent articles of the present invention may further comprise an absorbent core joined with the topsheet, the backsheet, or both in any manner as is known by attachment means such as those well known in the art. Embodiments of the present invention are envisioned wherein portions of the entire absorbent core are unattached to either the topsheet, the secondary topsheet, the backsheet, or more than one of these layers. The absorbent core can be formed from any of the materials well known to those of ordinary skill in the art. Examples of such materials include multiple plies of creped cellulose wadding, fluffed cellulose fibers, wood pulp fibers also known as airfelt, textile fibers, a blend of fibers, a mass or batt of fibers, airlaid webs of fibers, a web of polymeric fibers, and a blend of polymeric fibers. Other suitable absorbent core materials include absorbent foams such as polyurethane foams or high internal phase emulsion

("HIPE") foams. Suitable HIPE foams are disclosed in U.S. Pat. No. 5,550,167, U.S. Pat. No. 5,387,207, U.S. Pat. No. 5,352,711, and U.S. Pat. No. 5,331,015. The absorbent core can comprise superabsorbent materials such as absorbent gelling materials (AGM), including AGM fibers, as is known in the art.

The absorbent articles of the present invention may have a pair of flaps on longitudinal sides of a body-facing surface for folding around and securing the absorbent article to the undergarment, the flaps comprising the first layer and the backsheet. Alternatively, the flaps can comprise the first layer, the second layer, and the backsheet. The layers in the flaps can be laminated by either adhesive or thermally bonded means, where thermal bonding includes but is not restricted to technologies such as ultrasonic bonding, cold pressure bonding, and hot pressure bonding. The flaps may have a plurality of third discrete features thereon. The third discrete features may be the same as or different from the first discrete features or the optional second discrete features. In one embodiment, the plurality of third discrete features can be formed simultaneously with the plurality of first discrete features. In another embodiment where the topsheet further comprises a plurality of second discrete features, the plurality of third discrete features can be formed simultaneously with the plurality of second discrete features. For a plurality of third discrete features may be depressions formed toward a garment facing side of a topsheet. In one embodiment, depression type of third discrete features can be formed simultaneously with a plurality of first discrete features when the plurality of first discrete features are apertures toward a garment facing side of a topsheet.

The invention is applicable to the production of absorbent articles from discrete components, and it is particularly advantageous for the production of absorbent articles from at least one continuous sheet or web.

A schematic representing a method according to the invention is depicted in FIG. 1. In FIG. 1, the machine direction is from left to right. The method of the invention may form the absorbent article upside down. Alternatively, the absorbent article can be formed top-side up.

The process 1 carried out according to the example in FIG. 1 comprises supplying a second layer 12 onto a first layer 11 to form a composite 31 of the first layer 11 and the second layer 12, feeding the composite 31 to a first discrete feature forming unit 211 to form a first deformed composite 32. Though the process shown in FIG. 1 indicates a step of composite formation and a step of first discrete features formation are carried out sequentially, these two steps can be carried out simultaneously as shown in FIG. 3.

In one example, the first discrete feature forming units 211 may comprise a pair of two generally cylindrical rollers wherein at least one of the two rollers has discrete feature forming elements on its surface. In another example when the first discrete features are apertures, the first discrete feature forming units 211 may comprise a means for weakening a web, composite 31 in this case, at a plurality of locations to create a plurality of weakened, melt-stabilized locations, and a means for applying a tensioning force to the composite 31 to rupture the composite 31 at the plurality of weakened, melt-stabilized locations creating a plurality of apertures in the composite 31 coincident with the plurality of weakened, melt-stabilized locations. Referring to FIGS. 4 and 7, a means for weakening web at a plurality of locations to create a plurality of weakened may be a web weakening roller arrangement 108 or 308, and a means for applying a

tensioning force to the web to rupture the web at the plurality of weakened may be a incremental stretching system **132** or **332** shown in FIGS. **4** and **7**.

Separately, a colored sheet web **13** is provided with a first colored region in a first coloration unit **231**, and then is supplied onto a second layer side of the first deformed composite **32**. When the colored sheet web **13** already has a first colored region before conducting the first coloration step, the first coloration step may be skipped, or still employed to provide an additional colored region on the colored sheet web **13**. Then, the colored sheet web **13** and the first deformed composite **32** are integrated to form an integrated composite **34** in an integration unit **251**. And then, a backsheet web **15** is supplied onto a colored sheet web side of the integrated composite **34** and integrated by peripheral sealing along a peripheral line of an absorbent article in a peripheral seal unit **261** to form an absorbent article assembly **36**. The absorbent article assembly **36** is cut in a cutting unit **271** into individual absorbent articles **37**.

Referring to FIG. **2**, there is shown another example of a method according to the invention with several optional steps. In the process **2** carried out in FIG. **2**, initially a first layer **11** is produced with a second colored region in a second coloration unit **241**. The second colored region can be provided on either side of the first layer **11**. Alternatively, the second colored region can be provided in a second layer **12**. When the first layer **11** or the second layer **12** already has a second colored region before conducting the second coloration step, the second coloration step may be skipped, or still employed to provide additional colored region on the first layer **11** or the second layer **12**. The second layer **12** is supplied onto the colored first layer **40** to form a composite **41** of the colored first layer **40** and the second layer **12**, the composite **41** is fed into a first discrete feature forming unit **211** to form a first deformed composite **42**, and the first deformed composite **42** is fed into a second discrete feature forming unit **221** to form a second deformed composite **43**. A step of forming the composite **41** and a step of forming the first discrete features can be carried out sequentially as illustrated in FIG. **2** or simultaneously as shown in FIG. **3**.

In one example, the first and second discrete feature forming units **211** and **221**, respectively, may comprise a pair of two generally cylindrical rollers wherein at least one of the two rollers in each unit has discrete feature forming elements on its surface.

In another example, when the first discrete features are apertures, the first discrete feature forming units **211** may comprise a means for weakening a web, composite **41** in this case, at a plurality of locations to create a plurality of weakened, melt-stabilized locations, and a means for applying a tensioning force to the composite **41** to rupture the composite **41** at the plurality of weakened, melt-stabilized locations creating a plurality of apertures in the composite **41** coincident with the plurality of weakened, melt-stabilized locations. Referring to FIGS. **4** and **7**, a means for weakening web at a plurality of locations to create a plurality of weakened may be a web weakening roller arrangement **108** or **308**, and a means for applying a tensioning force to the web to rupture the web at the plurality of weakened may be a incremental stretching system **132** or **332** shown in FIGS. **4** and **7**.

Then, the colored sheet web **13** is supplied onto a second layer side of the second deformed composite **43**. The colored sheet web **13**, before being supplied onto the second deformed composite **43** to form an integrated composite **44**, is provided with a first colored region in a first coloration unit **231**, and may be cut into a predetermined size and

shape, then is supplied onto a second layer side of the second deformed composite **43**. When the colored sheet web **13** already has a first colored region before conducting the first coloration step, the first coloration step may be skipped, or still employed to provide additional colored region on the colored sheet web **13**. Then, the second deformed composite **43** and the colored sheet web **13** are integrated to form an integrated composite **44**, and an absorbent core **14**, which can be a continuous sheet or in a determined size and shape, is supplied onto a colored sheet web side of the integrated composite **44** to form a core layered composite **45**. A backsheet web **15** is supplied and adhered onto the absorbent core side of the core layered composite **45**, and integrated by peripheral sealing along a peripheral line of an absorbent article in a peripheral seal unit **261** to form an absorbent article assembly **46**. The absorbent article assembly **46** is then cut by a cutting unit **271** into individual absorbent articles **47**.

The first layer **11** can have a plurality of discrete extended elements which may be formed in a step continuously proceeding with a method according to the invention. Formation of a plurality of discrete extended elements can be carried out prior to formation of a plurality of first discrete features. Referring to FIG. **9**, the first layer **11** is fed into a discrete extended elements forming unit **281** to form a plurality of discrete extended elements before forming a first deformed composite **52**. Examples of the discrete extended elements forming unit **281** and discrete extended elements forming processes are disclosed in WO 10/105009; WO 10/105002; WO 10/105017; WO 11/112213; and WO 12/148936.

Referring to FIG. **10**, there is shown another example of a method according to the invention. The process **3** carried out according to the example in FIG. **10** comprises feeding a laminate **61** comprising a first layer and a second layer to a first discrete feature forming unit **211** to form a first deformed laminate **62**. Following steps may be conducted according to the process of the example of FIG. **1** or FIG. **2**. When the following steps is conducted according to FIG. **1**, a colored sheet web **13** is provided with a first colored region in a first coloration unit **231**, and then is supplied onto a second layer side of the first deformed laminate **62**. When the colored sheet web **13** already has a first colored region before conducting the first coloration step, the first coloration step may be skipped, or still employed to provide an additional colored region on the colored sheet web **13**. Then, the colored sheet web **13** and the first deformed laminate **62** are integrated to form an integrated laminate **64** in an integration unit **251**. And then, a backsheet web **15** is supplied onto a colored sheet web side of the integrated laminate **64** and integrated by peripheral sealing along a peripheral line of an absorbent article in a peripheral seal unit **261** to form an absorbent article assembly **66**. The absorbent article assembly **66** is then cut in a cutting unit **271** into individual absorbent articles **67**. The process according to FIG. **10** may comprise a step of providing a second colored region on either the first layer side or the second layer side of the laminate **61** prior to the step of forming the first discrete features on the laminate **61**. The process according to FIG. **10** may further comprise at least one of the optional steps described in respect with FIG. **2**.

In the examples above, the first and second discrete feature forming units **211** and **221**, respectively, may comprise two generally cylindrical rolls wherein at least one of the two rolls in each unit has discrete feature forming elements on its surface.

In another example, when the first discrete features are apertures, the first discrete feature forming units **211** may comprise a means for weakening a web, a laminate **61** comprising a first layer and a second layer in this case, at a plurality of locations to create a plurality of weakened, melt-stabilized locations, and a means for applying a tensioning force to the laminate **61** to rupture the laminate **61** at the plurality of weakened, melt-stabilized locations creating a plurality of apertures in the laminate **61** coincident with the plurality of weakened, melt-stabilized locations. Referring to FIGS. **4** and **7**, a means for weakening web at a plurality of locations to create a plurality of weakened may be a web weakening roller arrangement **108** or **308**, and a means for applying a tensioning force to the web to rupture the web at the plurality of weakened may be an incremental stretching system **132** or **332** shown in FIGS. **4** and **7**. Formation of First Discrete Features and Optional Second Discrete Features

In the present invention, the first discrete features and the optional second discrete features may be of any suitable configuration. Suitable configurations for the features include, but are not limited to: apertures; ridges (continuous protrusions) and grooves (continuous depressions); tufts; columnar shapes; dome-shapes, tent-shapes, volcano-shapes; features having plan view configurations including circular, oval, hour-glass shaped, star shaped, polygonal, polygonal with rounded corners, and the like, and combinations thereof. Polygonal shapes include, but are not limited to rectangular (inclusive of square), triangular, hexagonal, or trapezoidal. In one embodiment, the first discrete features are features selected from the group consisting of apertures, protrusions, depressions, tufts, and combinations thereof, and the second discrete feature are features selected from the group consisting of apertures, protrusions, depressions, tufts, and combinations thereof. In another embodiment where the topsheet further comprises second discrete features, the first discrete features are apertures and the second discrete features are tufts.

The first discrete features and the second discrete features may differ from each other in terms of one or more of the following properties: type, shape, size, aspect ratio, edge-to-edge spacing, height or depth, density, color, surface treatment (e.g., lotion, etc.), number of web layers within the features, and orientation (protruding from different sides of the web). The term "type", as used herein, refers to whether the feature is an aperture, a protrusion such as a tuft and other kind of protrusion, or a depression. In the present invention, discrete features may be of any suitable size. Typically, either the first features or the optional second feature may be macroscopic. In some embodiments, the first features and the second features may both be macroscopic. The plan view area of the individual features may, in some embodiments of the web, be greater than or equal to about 0.5 mm^2 , 1 mm^2 , 5 mm^2 , 10 mm^2 , or 15 mm^2 , or lie in any range between two of these numbers. The methods described herein can, however, be used to create first features and/or second features that are microscopic which have plan view areas less than 0.5 mm^2 .

Various methods and apparatuses for deforming webs by forming discrete features on webs known in the art can be utilized to form the first and the optional second discrete features in the present application. Patents disclosing such methods include: U.S. Pat. No. 4,189,344; U.S. Pat. No. 4,276,336; U.S. Pat. No. 4,609,518; U.S. Pat. No. 5,143,679; U.S. Pat. No. 5,562,645; U.S. Pat. No. 5,743,999; U.S. Pat. No. 5,779,965; U.S. Pat. No. 5,998,696; U.S. Pat. No. 6,332,955; U.S. Pat. No. 6,739,024; US Patent Application

Publication 2004/0110442 A1; EP 1 440 197 B1; U.S. Pat. No. 6,916,969; US Patent Application Publication No. 2006/0151914 A1; U.S. Pat. No. 7,147,453; U.S. Pat. No. 7,423,003; U.S. Pat. No. 7,323,072; US Patent Application Publication No. 2006/0063454 A1; US Patent Application Publication No. 2007/0029694 A1; US Patent Application Publication No. 2008/0224351 A1; US Patent Application Publication No. 2009/0026651 A1; U.S. Pat. No. 7,521,588; US Patent Application Publication No. 2010/0201024 A1; WO2012/148980; WO2012/149074; WO2012/148935; and WO2012/148946.

One type of features preferred for discrete features in the present invention are apertures. Apertures in a topsheet in an absorbent article may enhance penetration of body exudates through the topsheet into the underlying secondary topsheet or absorbent core. Various methods and apparatuses for forming apertures are disclosed in the patent literature. Patents disclosing such methods include: U.S. Pat. No. 8,241,543, U.S. Pat. No. 3,355,974; U.S. Pat. No. 2,748,863 and U.S. Pat. No. 4,272,473 disclosing aperture forming methods using apparatus having heated aperture forming elements; U.S. Pat. No. 5,628,097 disclosing a method for selectively aperturing a nonwoven web or a laminate by weakening the web at a plurality of locations; U.S. Pat. No. 5,735,984 disclosing ultrasonic aperturing; U.S. Pat. Nos. 4,342,314 and 4,463,045 disclosing vacuum aperturing; U.S. Pat. Nos. 4,609,518; 4,629,643 and 4,695,422 disclosing hydroforming apertures; and U.S. Pat. No. 5,628,097 disclosing weakening a web along a plurality of locations and then applying a tensioning force to the web causing the web to rupture at the plurality of weakened location.

Referring to FIG. **4** there is schematically illustrated a process **100** for selectively aperturing a web. A web may be a composite comprising a first layer and a second layer layer, or a laminate comprising a first layer and a second layer.

According to the present invention, a web **10** travels and passes through a nip **106** of the web weakening roller arrangement **108** formed by rollers **110** and **112**.

Referring to FIGS. **4** and **5**, the web weakening roller arrangement **108** preferably comprises a patterned calendar roller **110** and a smooth anvil roller **112**. One or both of the patterned calendar roller **110** and the smooth anvil roller **112** may be heated and the pressure between the two rollers may be adjusted by well known means to provide the desired temperature, if any, and pressure to concurrently weaken and melt-stabilize the web **10** at a plurality of locations.

The patterned calendar roller **110** is configured to have a circular cylindrical surface **114**, and a plurality of protuberances or pattern elements **116** which extend outwardly from surface **114**. The protuberances **116** are disposed in a predetermined pattern with each protuberance **116** being configured and disposed to precipitate a weakened, melt-stabilized location in the web **10** to effect a predetermined pattern of weakened, melt-stabilized locations in web **10**. As shown in FIG. **5**, patterned calendar roller **110** has a repeating pattern of protuberances **116** which extend about the entire circumference of surface **114**. Alternatively, the protuberances **116** may extend around a portion, or portions of the circumference of surface **114**.

The protuberances **116** are preferably truncated conical shapes which extend radially outwardly from surface **114** and which have elliptical distal end surfaces **117** although it is not intended to thereby limit the scope of the present invention to protuberances of only this configuration. Other suitable shapes for distal ends **117** include, but are not limited to circular, square, rectangular, etc. The roller **110** is finished so that all of the end surfaces **117** lie in an imaginary

11

right circular cylinder which is coaxial with respect to the axis of rotation of roller **110**. The protuberances **116** are disposed in a regular predetermined pattern of rows and columns in the embodiment shown in FIG. **5**, although it is not intended to thereby limit the scope of the present invention to the pattern of protuberances of only this configuration. The protuberances may be disposed in any predetermined pattern about patterned calendar roller **110**.

Anvil roller **112** is preferably a smooth surfaced, right circular cylinder of steel.

Referring now to FIG. **6**, there is shown a fragmentary enlarged view of the incremental stretching system **132** comprising incremental stretching rollers **134** and **136**. The incremental stretching roller **134** includes a plurality of teeth **160** and corresponding grooves **161** which extend about the entire circumference of roller **134**. Incremental stretching roller **136** includes a plurality of teeth **162** and a plurality of corresponding grooves **163**. The teeth **160** on roller **134** intermesh with or engage the grooves **163** on roller **136**, while the teeth **162** on roller **136** intermesh with or engage the grooves **161** on roller **134**. As the web **10** having weakened, melt-stabilized locations **202** passes through the incremental stretching system **132** the web **10** is subjected to tensioning in the CD or cross-machine direction causing the web **10** to be extended in the CD direction. Alternatively, or additionally the web **10** may be tensioned in the MD or machine direction. The tensioning force placed on the web **10** is adjusted such that it causes the weakened, melt-stabilized locations **202** to rupture creating a plurality of apertures **204** coincident with the weakened melt-stabilized locations **202** in the web **10**. However, the bonds of the web **10** are preferably strong enough such that they do not rupture during tensioning, thereby maintaining the web **10** in a coherent condition even as the weakened, melt-stabilized locations rupture. However, it may be desirable to have some of the bonds rupture during tensioning.

Other exemplary structures of incremental stretching mechanisms suitable for incrementally stretching or tensioning the web are described in WO 95/03765 the disclosure of which is incorporated herein by reference.

The web **10** is preferably taken up on wind-up roller **180** and stored. Alternatively, the web **10** may be fed directly to a production line where it is used to form a topsheet on a disposable absorbent article.

Referring to FIG. **7** there is schematically illustrated at **300** another process for selectively aperturing a web. A web **10** is forwarded through the weakening arrangement **308**, and passed directly through the weakening arrangement **308**.

Referring to FIGS. **7** and **8**, the weakening arrangement **308** preferably comprises an ultrasonic transducer **306** and a cylinder **310**. As web **10** is forwarded between the ultrasonic transducer **306** and the anvil cylinder **310**, the web **10** is subjected to ultrasonic vibrational energy whereupon predetermined pattern locations of the web **10** are weakened and melt-stabilized. Anvil **310** has a multiplicity of discrete pattern protuberances which are generally designated **316** disposed on its outwardly facing surface **314** in a predetermined pattern which extends about the entire circumference of the anvil cylinder. The protuberances **316** are disposed in a predetermined pattern with each protuberance **316** being configured and disposed to precipitate a weakened, melt-stabilized location **304** in the web **10** to effect a predetermined pattern of weakened, melt-stabilized locations in the web **10**. As shown in FIG. **8**, anvil **310** has a repeating pattern of protuberances **316** which extend about the entire circumference of surface **314**. Alternatively, the protuber-

12

ances **316** may extend around a portion, or portions of the circumference of surface **314**.

The protuberances **316** are preferably truncated conical shapes which extend radially outward from the surface **314** and which have elliptical distal end surfaces. Other suitable shapes for the distal end include, but are not limited to, circular, square, rectangular, etc. The anvil **310** is finished so that all of the end surfaces lie in an imaginary right circular cylinder which is coaxial with respect to the axis of rotation of anvil **310**.

After having passed through the weakening arrangement **308**, and prior to passing through the nip **330** of the incremental stretching system **332**, the web **10** includes a plurality of weakened, melt-stabilized locations **304** which generally correspond to the pattern of protuberances **316** extending from the surface **314** of anvil **310**.

From the weakening arrangement **308**, the web **10** passes through nip **330** formed by the incremental stretching system **332** employing opposed pressure applicators having three-dimensional surfaces which at least to a degree are complementary to one another. The incremental stretching system **332** preferably comprises incremental stretching rollers **334** and **336**. The incremental stretching roller **334** includes a plurality of teeth and corresponding grooves which extend about the entire circumference of the roller **334**. Incremental stretching roller **336** includes a plurality of teeth and a plurality of corresponding grooves. Teeth on roller **334** intermesh or engage with the grooves on roller **136**, while the teeth on roller **336** intermesh with or engage with the grooves on the roller **334**. As the web **10** having weakened, melt-stabilized locations **304** passes through the incremental stretching system **332**, the web **10** is subjected to tensioning causing the web **10** to be extended. The tensioning force placed on the web **10** is adjusted such that it causes the weakened, melt-stabilized locations **304** to rupture creating a plurality of apertures in the web **10** which are coincident with the weakened melt-stabilized locations.

Another type of discrete features preferred in the present invention, especially when at least one of the first and second layers is nonwoven, are tufts. In many applications, it is desirable that fibrous webs have a bulky texture and/or softness. Composites or laminates comprising a nonwoven in which nonwoven fibers protrude or are partially exposed through a polymer film or nonwoven can be useful as a topsheet in absorbent articles as they provide an absorbent structure in which the nonwoven acts as the conveyor of fluid. As a non-limiting example, the composite or laminate comprises a polymer film and a nonwoven structured such that the fluid collecting side of the composite or laminate is the polymer film, and nonwoven fibers protrude or are partially exposed through the polymer film to the fluid collecting side.

Various methods and apparatuses for forming tufts disclosed in patent literature. Patents disclosing such methods include: U.S. Pat. Nos. 3,485,706, 4,465,726 and 4,379,799 disclosing forming tufts using waterjet; U.S. Pat. No. 4,741,941 disclosing forming tufts using air drawing; U.S. Pat. No. 5,080,951 disclosing a needle punching method; and WO 1994/058117, WO 2004/59061, and WO 2010/117636 disclosing a method for making tufts on a web using an apparatus comprising a roller comprising a plurality of ridges and grooves.

In one embodiment, when both the first and second discrete features are formed by rolls, the first discrete features are formed by feeding a composite **31**, **41** of a first layer and a second layer, or a laminate **61** comprising a first layer and a second layer in a machine direction into a first

nip that is formed between two generally cylindrical rolls, the two rolls having surfaces wherein at least one of the two rolls has first discrete feature forming elements on its surface, and when the composite or laminate is fed into the nip, the composite or laminate is deformed. The second discrete features are formed by feeding a first deformed composite **32**, **42** or a first deformed laminate **62** in a machine direction into a second nip that is formed between two generally cylindrical rolls, the two rolls having surfaces wherein at least one of the two rolls has second discrete feature forming elements on its surface. The two rolls forming the first discrete features and the two rolls forming the second discrete features can be separate pairs of rolls. When apertures as first or second discrete features are formed according to the method disclosed in U.S. Pat. No. 5,628,097, the composite **31**, **41** or the laminate **61** is weakened at a plurality of locations by for example heat and/or pressure prior to being fed into a nip formed between two rolls.

In another embodiment when both the first and second discrete features are formed by rolls, the two rolls forming the first discrete features and the two rolls forming the second discrete features can share one roller between the two pairs of rolls. As shown in FIG. 11A and FIG. 11B respectively, the first discrete features are formed by feeding a composite **41** of a first layer and a second layer, or a laminate **61** comprising a first layer and a second layer in a machine direction into a first nip **305** that is formed between a first generally cylindrical roller **301** and a second generally cylindrical roller **302**, and a first deformed composite **42** or a first deformed laminate **62** is prepared. Continuously, the second discrete features are formed by introducing the first deformed composite **42** or the first deformed laminate **62** in a machine direction into a second nip **307** that is formed between the second generally cylindrical roller **302** and a third generally cylindrical roller **303**, forming a second deformed composite **43** or a second deformed laminate **63**. Referring to FIG. 11C, there is shown in more detail the portion of means of forming the first and second discrete features shown in FIG. 11A that can form second deformed composite **43** having first and second discrete features. The particular placement of the first discrete features and the second discrete features on the composite **41** can depend on, for example, the arrangement of the absorbent article in which the second deformed composite **43** will ultimately be incorporated. For example, first discrete features may be formed into a region of the composite **41** which will be a central region of an absorbent article, and second discrete features may be formed into a region which will be an edge region surrounding the central region of an absorbent article.

In the illustrated embodiment, the first discrete features **113** and the second discrete features **123** include structural modifications formed by urging discrete portions of the composite **41** in a first direction while concurrently urging other discrete portions of the first deformed composite **42** in a different, opposite direction. More specifically, apertures **113** are formed by rolls **301** and **302** urging discrete portions of the composite **41** in a first direction and tufts **123** are formed by rolls **302** and **303** urging discrete portions of the first deformed composite **42** in a second direction. In the illustrated embodiment, the first and second directions generally extend in opposite directions that are parallel to the Z-direction.

Each of rolls **301**, **302** and **303** rotates about an axis A, the axis A being parallel and in the same plane.

Roller **301** comprises a plurality of ridges **101** and corresponding grooves **102** which extend unbroken about the

entire circumference of roller **301**. In some embodiments, depending on what kind of pattern is desired as first discrete features, roller **301** can comprise ridges **101** wherein portions have been removed, such as by etching, milling or other machining processes, such that some or all of ridges **101** are not circumferentially continuous, but have breaks or gap. The breaks or gaps can be arranged to form a pattern.

Rolls **302** and **303** can each comprise a plurality of ridges **101** and corresponding grooves **102** which can extend unbroken about the entire circumference of the corresponding roller. The roller **302** comprises a plurality of rows of circumferentially-extending ridges that have been modified to be rows of circumferentially-spaced teeth **111** that extend in spaced relationship about at least a portion of the corresponding roller. The individual rows of teeth **111** can be separated by corresponding grooves **112**. The roller **303** comprises a plurality of rows of circumferentially-extending ridges that have been modified to be rows of circumferentially-spaced teeth **121** that extend in spaced relationship about at least a portion of the corresponding roller. The individual rows of teeth **121** can be separated by corresponding grooves **122**. In operation, rolls **302** and **303** intermesh such that the ridges **101** of one roller extend into the grooves **122** or **112** of the other roller, the teeth **111** of roller **302** extend into the grooves **122** of roller **303**, and the teeth **121** of roller **303** extend into the grooves **112** of roller **302**.

All or any one of rolls **301**, **302** and **303** can be heated by means known in the art such as by incorporating hot oil filled rollers or electrically-heated rollers. Alternatively, both or either of the rolls may be heated by surface convection, induction, or by surface radiation.

In another embodiment, the first and the second discrete features are formed simultaneously by feeding a composite **31**, **41** or a laminate **61** in a machine direction into a nip nip that is formed between two rolls, the rolls having surfaces wherein at least one of the two rolls has first discrete feature forming elements on its surface and at least one of the two rolls has second discrete feature forming elements on its surface, and when the composite **41** or the laminate **61** is fed into the nip, the composite **41** or the laminate **61** is deformed. In another embodiment, when one roller has first discrete feature forming elements on its surface, the other roller can have second discrete feature forming elements on its surface, causing features to be formed in opposite directions. When apertures as either first or second discrete features are formed according to the method disclosed in U.S. Pat. No. 5,628,097, the composite **31**, **41** or the laminate **61** is weakened at a plurality of locations by for example heat and/or pressure prior to being fed into a nip formed between two rolls.

The rolls used in the apparatuses and methods described herein are typically generally cylindrical. The term “generally cylindrical”, as used herein, encompasses rolls that are not only perfectly cylindrical, but also cylindrical rolls that may have elements on their surface. The term “generally cylindrical” also includes rolls that may have a step-down in diameter, such as on the surface of the roller near the ends of the roller. It also includes ring rolls having meshing teeth. This can enable forming deformed elements of different heights in respective zones of the same roller. The rolls are also typically rigid, that is, substantially non-deformable.

WO 2012/148935 discloses several mechanical deformation processes for forming discrete features such as an approach utilizing a single nip with two rolls comprising discrete male forming elements wherein at least one roller comprises two or more raised ridges, and another approach comprising a multi-hit (multi-nip) configuration that enables

controlled placement and orientation of multiple sets of features. Each of these approaches may enable independent control of the features formed in a multi-layer structure, providing additional control over the function and aesthetics of the features. For example, this process could provide the ability to create multi-layer structures where some features have more layers through their thickness than other features.

In one embodiment, the first discrete feature forming elements or the second discrete feature forming elements can be heated.

In one embodiment when a plurality of the first and/or second discrete features are apertures, the first and/or the second discrete feature forming elements can comprise rounded teeth or triangular shaped teeth disclosed in WO 2005/13874. Alternatively, in the embodiment, the first and/or the second discrete feature forming elements can comprise being tapered from a base and a tip wherein the base of each tooth has a cross-sectional length dimension greater than a cross-sectional width dimension, wherein each tooth is oriented such that the cross-sectional length dimension of the tooth is disposed at an angle greater than zero relative to a predominant molecular orientation of the polymer film as described in WO 2010/90974.

In another embodiment, the first layer is polymer film having apertures.

In another embodiment, the first deformed composite **32**, **42** the second deformed composite **43**, the first deformed laminate **62**, the second deformed laminate **63** may be ring rolled with intermeshing rolls after forming the first or second discrete features, especially after forming apertures. Ring-rolling composites or laminates after forming discrete features, especially apertures, is expected to result in an increase in the size of the apertures and increase in the air permeability of the film.

In another embodiment when a plurality of second discrete features are tufts, the first discrete feature forming elements can comprise a plurality of ridges and corresponding grooves which extend unbroken about the entire circumference of a roller which has the second discrete feature forming elements discloses in WO 2004/59061, and WO 2010/117636. The tufts may comprise a plurality of tufted fibers being integral extensions of the nonwoven. In another embodiment when the second layer is a nonwoven, and a plurality of second discrete features are tufts, at least part of the distal portion of each of the tufts is covered by a cap, each cap being an integral extension of the first layer extending over the distal portion of a discrete tuft.

Provision of a Colored Region on Colored Sheet

In the present invention, a first colored region on a colored sheet web can be provided by various methods and apparatus well known to those skilled in the art such as lithographic, screen printing, flexographic, gravure ink jet printing techniques or a method of producing color change using an activatable colorant, and virtually any graphic in any color or color combination can be rendered on the colored sheet web. Patents disclosing such methods include: U.S. Pat. No. 7,736,688 disclosing flexographic printing; WO 2011/25486 disclosing a method of manufacturing an absorbent article having two colored regions and a method of color measurement; and WO2011/133464 and WO2011/133462 disclosing a method of producing color change on a web using an activatable colorant.

Supplying and Integration of Colored Sheet Web

Hereinafter in this section of Supplying and Integration of Colored sheet web, a deformed composite collectively denotes a first deformed composite of a polymer film and a nonwoven when a second discrete features are not formed

and a second deformed composite of a polymer film and a nonwoven when a second discrete features are formed, and a deformed laminate collectively denotes a first deformed laminate of a polymer film and a nonwoven when a second discrete features are not formed and a second deformed laminate of a polymer film and a nonwoven when a second discrete features are formed.

A colored sheet web having a first colored region is introduced by an apparatus, such as a roller, onto the second layer side of the deformed composite or the deformed laminate; and the colored sheet web, and the deformed composite or the deformed laminate are both moving in a machine direction. The colored sheet web can be introduced onto the deformed composite or the the deformed laminate as either a continuous layer or a discrete sheet cut before supplied onto the deformed composite into a predetermined size and shape. A discrete sheet of the colored sheet web having a first colored region can be prepared by printing a plurality of first colored regions on a continuous liquid pervious colored sheet web and cutting the continuous liquid pervious colored sheet web into discrete sheets in a predetermined shape and size using a cutting means well known to those skilled in the art. The exact dimensions of the size and shape of the discrete sheets may be determined depending on type of an absorbent article. In one example, the colored sheet comprising a colored sheet web is in size and shape which is shorter in length than the final length of an absorbent article such that fluid cannot be transported or wicked to the end of the article. In another embodiment, the colored sheet comprising a colored sheet web extends to the periphery of the topsheet so that the colored sheet web layer underlies the topsheet on the entire inner surface of the topsheet. In the method according to the present invention, a colored sheet web and a composite of the first and second layers can be integrated by various methods and apparatus known to those skilled in the art. For examples, the integration can be carried out by a process selected from the group consisting of cold pressure bonding, heated pressure bonding, ultrasonic bonding, gluing and combinations thereof. Patents disclosing such methods include: U.S. Pat. Nos. 4,854,984 and 4,919,738 for cold pressure bonding.

In one embodiment, a colored sheet web having a first colored region in a predetermined size and shape, and a deformed composite or a deformed laminate can be integrated by heated pressure bonding method comprising forwarding a composite of the colored sheet web and the deformed composite or the deformed laminate through a generally cylindrical pattern defining roller and a mating anvil roller. The generally cylindrical pattern defining roller and mating anvil roller may be rotated at matched speeds or at differing speeds to one another.

Supplying and Integrating Backsheet Web

A backsheet web can be supplied by an apparatus such as an adhesive bonding roller or thermal sealing roller onto a colored sheet web side of the integrated composite **34**, **44**, or the integrated laminate **64** which are moving in a machine direction to form an absorbent article assembly **36**, **46**, **66**. When an absorbent core is optionally provided onto the integrated composite or integrated laminate, the backsheet web can be introduced onto an absorbent core side.

The backsheet web is integrated to the integrated composite or integrated laminate so that in an absorbent article a backsheet is preferentially peripherally joined with a topsheet using known techniques, either entirely so that the entire perimeter of the absorbent article is circumscribed by such joiner or are partially peripherally joined at the perimeter.

Severing Absorbent Article Assembly

The absorbent article assembly is severed or cut using by a cutting unit conventional in the technical area of absorbent article fabrication, such as flex knife, rotary die, ultrasonic, water jet, or laser cutting, into individual absorbent articles to have a predetermined size and shape.

Optional Steps

Registration/Phasing

Absorbent articles comprise multiple functional and/or aesthetic components including compositional elements such as a topsheet, a backsheet and optionally secondary topsheet and an absorbent core, and design elements such as colored regions, discrete features formed on a topsheet, and optionally channels and a logo. During the manufacturing of absorbent articles, the position of components of article in each step of the manufacturing process may affect the overall quality of the articles and the acceptance of the articles by consumers, as consumers often desire consistency in the configuration of purchased goods for both functional and aesthetic reasons. For example, locations of the first discrete features, the second discrete feature, the first colored region and/or the second colored region need to be controlled as designed to secure best functional and aesthetic goods. To ensure consistency throughout the manufacturing process, components must be positioned uniformly.

Various methods and systems for inspecting the locations of selected components of an absorbent article during a manufacturing process have been known. Patents disclosing such methods and systems include: U.S. Pat. No. 5,359,525; EP 2090 951 A1; and WO 2012/161709 disclosing system and method of the automated regulation of production lines. In a method according to the present invention, a phasing can be conducted in between two consecutive steps to determine and control position of at least one component, and may be carried out at least once.

Formation of Apertures in Web

In one embodiment, a method according to the present invention may further comprise a step of forming a plurality of apertures on a first layer prior to forming a composite of the first layer and a second layer. In another embodiment, a method according to the present invention, when the second layer is a polymer film, further comprises a step of forming a plurality of apertures on the polymer film prior to forming a composite of the first layer and a second layer. Aperturing methods described in the section of "Formation of First Discrete Features and Optional Second Discrete Features" above are applicable for aperture formation on the polymer film.

Formation of a Plurality of Discrete Extended Elements

A method according to the present invention optionally comprises a step of forming a plurality of discrete extended elements on a first layer, a composite of a first layer and a second layer, or a laminate comprising a first layer and a second layer when at least the first layer is a polymer film.

Hereinafter in this section of Formation of a Plurality of Discrete Extended Elements, a first layer, a composite a first layer and a second layer and a laminate comprising a first layer and a second layer are collectively denoted as a precursor web. It can be beneficial for the precursor web to have a textured surface by having a plurality of discrete extended elements which can provide the surface of the polymer film with a desirable feel, visual impression, and/or audible impression.

A plurality of discrete extended elements can be made in a vacuum forming process, a hydroforming process, a high static pressure forming process, a solid state deformation

process in mated forming structures, or methods using a forming structure and a compliant substrate. With a typical vacuum forming process, a precursor web is heated and placed over a forming structure. Then a vacuum forces the precursor web to conform to the texture of the forming structure. The resulting web has texture that can provide a soft and silky tactile impression, depending upon the texture of the forming structure and degree of conformation. With a typical hydroforming process, a precursor web is placed over a forming structure and high pressure and high temperature water jets force the precursor web to conform to the texture of the forming structure. A high static pressure forming process employs a high pressure gas to deform the precursor web to the texture of a forming structure as disclosed in WO 10/105002, WO 10/105017 and WO 11/112213, while solid state deformation conveys the web between mating forming structures as disclosed in WO 12/148936, or uses a compliant substrate to impress the discrete extended elements into the precursor web as disclosed in WO 10/105009 and WO 10/105019.

A plurality of discrete extended elements in the present invention, especially when the first layer is a polymer film, comprise open proximal ends, open or closed distal ends, and sidewalls, wherein the discrete extended elements comprise thinned portions at the distal ends of the discrete extended elements and/or along the sidewalls of the discrete extended elements, and wherein (a) the discrete extended elements have a diameter of less than about 500 microns, (b) the discrete extended elements have an aspect ratio of at least about 0.2, and/or (c) the polymer film comprises at least about 95 discrete extended elements per square centimeter.

In an embodiment, a plurality of discrete extended elements can be formed by a process comprising the steps of: i) providing a forming structure comprising a plurality of discrete protruded elements and lands completely surrounding the discrete protruded elements; ii) providing a compliant substrate; iii) providing a precursor web between the compliant substrate and the forming structure; and iv) providing pressure between the compliant substrate and the forming structure sufficient to conform the precursor web to the discrete protruded elements of the forming structure to form the embossed web.

In another embodiment, a plurality of discrete extended elements can be formed by a process comprising the steps of: i) feeding a precursor web between a static gas pressure plenum and a forming structure comprising a plurality of discrete protruded elements, the discrete protruded elements having a height of at least substantially equal to a thickness of the precursor web; and ii) applying pressure from the static gas pressure plenum against the precursor web opposite the forming structure creating a pressure differential across the precursor web sufficient to conform the precursor web to the discrete protruded elements of the forming structure.

In another embodiment, a plurality of discrete extended elements can be formed by a process comprising the steps of: i) feeding a precursor web between a static gas pressure plenum and a forming structure comprising a plurality of discrete apertures, discrete depressions, or combinations thereof, the apertures or depressions having a depth of at least substantially equal to a thickness of the precursor web; and ii) applying pressure from the static gas pressure plenum against the precursor web opposite the forming structure creating a pressure differential across the precursor web sufficient to force the precursor web into the apertures or

depressions of the forming structure, thereby forming the precursor web comprising a plurality of discrete extended elements.

In another embodiment, a plurality of discrete extended elements can be formed by a process comprising the steps of: i) providing a precursor web, ii) providing a pair of mated forming structures, including a first forming structure and a second forming structure, wherein at least the first forming structure comprises voids, and wherein at least the second forming structure comprises protrusions; and iii) moving the web through a deformation zone between the mated forming structures, wherein the voids of the first forming structure engage with the protrusions of the second forming structure at an engagement position.

Provision of a Second Colored Region

A method according to the present invention optionally comprises a step of providing a second colored region on the polymer film or the nonwoven prior to formation of the first discrete features. The second colored region can be provided either side of the polymer film or the nonwoven.

Coloration methods described in the section of Provision of a Colored Region on Colored Sheet above are applicable for coloration of the second colored region.

Introduction of Absorbent Core

A method according to the present invention optionally further comprises a step of supplying a precursor absorbent core to a colored sheet web side of an integrated composite **34**, **44**, or an integrated laminate **64**, moving in a machine direction. The absorbent core can be supplied as a preformed core. In one embodiment, the absorbent core is cut in a predetermined size and shape before being provided onto the colored sheet web side of the integrated composite. An absorbent core can be integrated to the integrated composite or an integrated laminate by various methods and apparatus known in the art such as cold pressure bonding, heated pressure bonding, ultrasonic bonding, gluing and combinations thereof. In one embodiment, an absorbent core can be integrated to form the core layered composite by gluing.

Application of Lotion Composition

Treatments of an absorbent article with lotion have been proposed to provide skin health benefits and to allow fluid to be absorbed into the article. To provide an absorbent article treated with a lotion, a method of the present invention may further comprise a step of applying a lotion composition to at least a portion of a topsheet, the inner surface of the backsheets, and/or any substrate (or surface thereof) disposed between the topsheet and the backsheets such as a secondary topsheet and an absorbent core. The lotion composition can be a liquid, a solid or a semi-solid at room temperature, and comprise at least one skin benefit agent. The lotion composition can be applied in any known manner, in any known pattern, and to any known portion of the absorbent article, as is well known in the art of lotioned absorbent articles. For example, the lotion composition can be applied in a pattern of generally parallel stripes or bands. The lotion composition can be a lotion coating on any part of the article, and on either side of any layer, such as upper surfaces, or lower surfaces. In one embodiment, a lotion composition can be disposed on the inner surface of the topsheet by disposing the lotion composition on at least one of a lower side of a first layer, an upper side and a lower side of a second layer. The lotion can be applied prior to the first discrete forming step, after the first discrete forming step and/or after the second discrete forming step.

Application of Odor Control Composition

A method of the present invention may further comprise a step of applying an odor control composition. Use of a

fragrance composition and/or an odor control composition in absorbent articles has been proposed for controlling and reducing malodors in the articles. In general, suitable components for odor control compositions include reactive components. Reactive components include components that can react with malodors, such as ammonia-based malodors or sulphur-based malodors (i.e. "malodor reactive components"), and components that mask malodors and/or react with receptors of the nose to block the perception of malodor by the nose of a consumer (i.e. "malodor masking components"). Suitable reactive components are described, for example, in US 2008/0071238 A1 and WO 07/113778, and suitable masking components are described, for example, in WO 08/114226.

An odor control composition may be applied on or within a layer of an absorbent article in any known manner, in any known pattern, and to any known portion of the absorbent article, as is well known in the art of absorbent articles. This means that, since the absorbent article is constituted by a series of layers, the odor control composition is applied onto one of the surfaces of these layers. An odor control composition can be applied onto the surface of application with any possible application pattern. In some cases it is possible that the odor control composition is applied on more than one layer within the article.

The dimensions and values disclosed herein are not to be understood as being strictly limited to the exact numerical values recited. Instead, unless otherwise specified, each such dimension is intended to mean both the recited value and a functionally equivalent range surrounding that value. For example, a dimension disclosed as "40 mm" is intended to mean "about 40 mm".

Every document cited herein, including any cross referenced or related patent or application, is hereby incorporated herein by reference in its entirety unless expressly excluded or otherwise limited. The citation of any document is not an admission that it is prior art with respect to any invention disclosed or claimed herein or that it alone, or in any combination with any other reference or references, teaches, suggests or discloses any such invention. Further, to the extent that any meaning or definition of a term in this document conflicts with any meaning or definition of the same term in a document incorporated by reference, the meaning or definition assigned to that term in this document shall govern.

While particular embodiments of the present invention have been illustrated and described, it would be obvious to those skilled in the art that various other changes and modifications can be made without departing from the spirit and scope of the invention. It is therefore intended to cover in the appended claims all such changes and modifications that are within the scope of this invention.

What is claimed is:

1. A method for fabricating an absorbent article, the absorbent article comprising a liquid permeable topsheet comprising a first layer, a second layer, a plurality of first discrete features, and a plurality of second discrete features; a colored sheet comprising a colored sheet web having a first colored region; and a liquid impermeable backsheets comprising a backsheets web, the absorbent article having a body-facing surface comprising the first layer and a garment-facing surface positioned opposite to the body-facing surface, the method comprising the steps of:

- a) supplying the second layer onto the first layer to form a composite of the first layer and the second layer;
- b) forming the plurality of first discrete features on the composite of the first layer and the second layer via a

21

first nip defined between a first roll and a second roll, wherein at least one of the first roll and the second roll comprises first discrete feature forming elements;

- c) forming the plurality of second discrete features on the composite of the first layer and the second layer via a second nip defined between the second roll and a third roll to form a deformed composite, wherein at least one of the second roll and the third roll comprises second discrete feature forming elements;
- d) supplying the colored sheet web having the first colored region onto the second layer side of the deformed composite, and integrating the deformed composite and the colored sheet web to form an integrated composite;
- e) supplying the backsheet web onto the colored sheet web side of the integrated composite, and integrating the integrated composite and the backsheet web to form an absorbent article assembly; and
- f) severing the absorbent article assembly into individual absorbent articles,

wherein the absorbent article has a background region, wherein the background region and the first colored region are viewable from the body facing surface, and wherein the first colored region differs in color from the background region.

2. The method according to claim 1, wherein the first layer in step a) comprises a plurality of discrete extended elements, wherein the discrete extended elements comprise open proximal ends, open or closed distal ends, and sidewalls, wherein the discrete extended elements comprise thinned portions at the distal ends of the discrete extended elements and/or along the sidewalls of the discrete extended elements, and wherein

- a) the discrete extended elements have a diameter of less than about 500 microns;
- b) the discrete extended elements have an aspect ratio of at least about 0.2; or
- c) the first layer comprises at least about 95 discrete extended elements per square centimeter.

3. The method according to claim 2, wherein the first layer in step a) further comprises apertures wherein the apertures have a diameter bigger than that of the plurality of discrete extended elements.

4. The method according to claim 3, further comprising a step of providing the first layer with a second colored region by a second coloration technique carried out prior to step d), wherein the first colored region and the second colored region differ in color from the background region.

5. The method according to claim 3, wherein the first discrete features are features selected from the group consisting of apertures, protrusions, depressions, tufts and combinations thereof.

6. The method according to claim 3, further comprising a step of determining and controlling positions of at least one component of the absorbent article at least once during steps a) through f).

7. The method according to claim 3, wherein the first layer and second layer are integrated prior to step b) by an integration process selected from the group consisting of cold pressure bonding, heated pressure bonding, ultrasonic bonding, gluing and combinations thereof.

8. The method according to claim 1, further comprising a step of providing at least one of the first layer and the second layer with a second colored region by a second coloration technique carried out prior to steps b) and c), wherein the first colored region and the second colored region differ in color from the background region.

22

9. The method according to claim 1, wherein the first layer and second layer are integrated prior to step b) by an integration process selected from the group consisting of cold pressure bonding, heated pressure bonding, ultrasonic bonding, gluing and combinations thereof.

10. The method according to claim 1, wherein the plurality of first discrete features formed in step a) is apertures and formed by a method comprising the steps of:

- 1) weakening the composite of the first layer and the second layer at a plurality of locations to create a plurality of weakened, melt-stabilized locations; and
- 2) applying a tensioning force to the composite to cause the composite to rupture at the plurality of weakened, melt-stabilized locations creating a plurality of apertures in the composite coincident with the plurality of weakened, melt-stabilized locations.

11. The method according to claim 10, wherein the composite is weakened by at least one means selected from heat, pressure and a combination thereof.

12. The method according to claim 1, wherein the first layer is selected from a group consisting of polymer film, a nonwoven and a combination thereof, and the second layer is selected from a group consisting of a polymer film, a nonwoven and a combination thereof.

13. A method for fabricating an absorbent article, the absorbent article comprising a liquid permeable topsheet comprising a first layer, a second layer, a plurality of first discrete features, and a plurality of second discrete features that are different from the first discrete features; a colored sheet comprising a colored sheet web having a first colored region; and a liquid impermeable backsheet comprising a backsheet web, the absorbent article having a body-facing surface and a garment-facing surface positioned opposite to the body-facing surface, the method comprising the steps of:

- a) forming the plurality of first discrete features on a laminate comprising the first layer and the second layer;
- b) forming the plurality of second discrete features on the laminate comprising the first layer and the second layer to form a deformed laminate;
- c) supplying the colored sheet web having the first colored region onto the second layer side of the deformed laminate, and integrating the deformed laminate and the colored sheet web to form an integrated laminate;
- d) supplying the backsheet web onto the colored sheet web side of the integrated laminate, and integrating the integrated laminate and the backsheet web to form an absorbent article assembly; and
- e) severing the absorbent article assembly into individual absorbent articles,

wherein steps a)-d) are conducted in a continuous operation, wherein the absorbent article has a background region, wherein the background region and the first colored region are viewable from the body facing surface, and wherein the first colored region differs in color from the background region.

14. The method according to claim 13, wherein the steps a) and b) are carried out simultaneously.

15. The method according to claim 13, further comprising a step of providing the first layer with a second colored region by a second coloration technique carried out prior to step a) or step b), wherein the first colored region and the second colored region differ in color from the background region.

16. The method according to claim 13, wherein the first discrete features are features selected from the group consisting of apertures, protrusions, depressions, tufts and com-

23

binations thereof, and the second discrete feature are features selected from the group consisting of apertures, protrusions, depressions, tufts and combinations thereof.

17. The method according to claim 13, further comprising a step of determining and controlling positions of at least one component of the absorbent article at least once between steps (a) through (d).

18. The method according to claim 13, wherein the plurality of first discrete features formed in step a) is formed by a method comprising the steps of:

- 1) weakening the laminate comprising the first layer and the second layer at a plurality of locations to create a plurality of weakened, melt-stabilized locations; and
- 2) applying a tensioning force to the laminate to cause the laminate to rupture at the plurality of weakened, melt-stabilized locations creating a plurality of apertures in the laminate coincident with the plurality of weakened, melt-stabilized locations.

19. The method according to claim 18, wherein the laminate is weakened by at least one means selected from heat, pressure and a combination thereof.

20. The method according to claim 13, wherein the first layer is selected from a group consisting of polymer film, a nonwoven and a combination thereof, and the second layer is selected from a group consisting of a polymer film, a nonwoven and a combination thereof.

21. A method for fabricating an absorbent article, the absorbent article comprising a liquid permeable topsheet comprising a first layer, a second layer, a plurality of first discrete features, a plurality of second discrete features that are different from the first discrete features, and a topsheet colored region; a colored sheet comprising a colored sheet web comprising a colored sheet colored region; a liquid impermeable backsheet web, the absorbent article comprising a body-facing surface comprising the first layer and a garment-facing surface comprising the liquid impermeable backsheet web, the method comprising the step of:

- a. supplying the first layer having a first surface and a second surface;
- b. adding color to the second surface of the first layer to define the topsheet colored region;

24

c. following step b), overlaying the second layer onto the second surface of the first layer to form a topsheet composite of the first layer and the second layer;

d. following step c), forming the plurality of first discrete features in the topsheet composite;

e. concurrently with or following step d), forming the plurality of second discrete features in the topsheet composite;

f. following step e), supplying the colored sheet web;

g. following step f), adding color to the colored sheet web to define the colored sheet colored region;

h. following step g), integrating the colored sheet web and the topsheet composite;

i. following step h), adding an absorbent core to the integrated colored sheet web and topsheet composite;

j. following step i), overlaying the liquid impermeable backsheet web;

k. wherein steps a)-j) are conducted in a continuous operation, and

l. wherein both the topsheet colored region and the colored sheet colored region are viewable from the body-facing surface of the article.

22. The method according to claim 21, wherein step d) comprises imparting a pattern of weakened, melt-stabilized locations.

23. The method according to claim 21, wherein step e) comprises the creation of fiber tufts.

24. The method according to claim 21, wherein the first discrete features are substantially confined to a plane of the topsheet composite, and wherein the second discrete features at least in part extend from the plane of the topsheet composite.

25. The method according to claim 21, wherein the first discrete features comprise apertures and the second discrete features comprise fiber tufts.

26. The method according to claim 21, wherein the first layer is a polymer film and wherein the second layer is a nonwoven.

27. The method according to claim 21, wherein the first layer is a nonwoven and the second layer is a nonwoven.

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